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TECH » SCIENCE » WHEELS » HOME » OUTSIDE

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INSIDE
32-PAGE

DIY
HANDBOOK



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NEW CONTENDERS,
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22 RETHINKING THE
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**COOL
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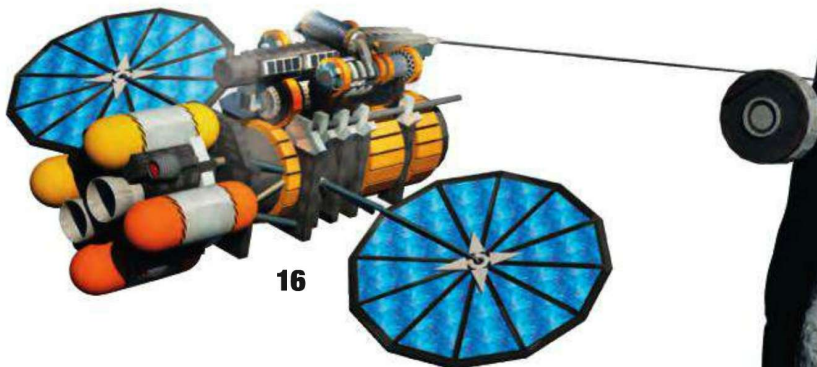
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Cover: DIY plane designer Cory Bird used carbon fibre to fabricate his beautiful two-seater, Symmetry, seen here in Mojave, California. This aeronautical work of art features a 149 kW engine and can achieve 457 km/h. Photograph by Jason Madara. **This page:** The M55 Terminus is a limited-edition “hybrid” bike propelled by a mix of human muscle and a powerful electric motor that provides just as much (or as little) assistance as required.



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WIN

A super-cool Vespa scooter plus accessories, all worth R70 000 (see page 71)



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PUBLISHED BY: RamsayMedia (Pty) Ltd

Chairman: Alan T Ramsay
Managing Director: Stuart Lowe
Directors: Terry Moolman, Gordon Utian, Brian Burnett, James Eedes, Simon Turck, Tim Holden, Peter Venn
HR Executive: Amanda Kirk, ICT Executive: Thomas Turck



Total monthly sales: 40 581 (April to June 2011)

Published and distributed by RamsayMedia (Pty) Ltd by permission of Hearst Communications Inc, New York, New York, United States of America.

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OF DELICIOUS CURVES and industrial chic

This month's cover story, "Build your own plane", celebrates some of the most interesting ideas and innovations in DIY flight: you'll meet the radical and disconcertingly over-powered *RP-4*, Cory Read's deliciously curved *Symmetry*, Chris Christianson's country-crossing *Savor* and Mark Stull's slightly scary *Lucky Stars*. Our story is likely to resonate with South African aviation enthusiasts who have designed (and in some cases, actually built) a variety of flying machines over the years, including microlights, gyrocopters and way-out kit planes that resemble something from an old episode of *Flash Gordon*.

Still with dream machines, we reveal some of the more entertaining car designs showcased at the recent Frankfurt Motor Show. Among our favourites is a Land Rover Defender concept that looks amazing but doesn't have a snowball's chance of entering production in its present form. We have mixed feelings about this. Although the Defender's basic design hasn't changed over the years and is long overdue for a makeover, we must admit to a twinge of regret when we contemplate a rounded and (gasp!) comfortable successor. There's something inexplicably appealing about industrial chic.

Are you a DIY practitioner? Do you enjoy building things, fixing stuff and generally making yourself useful around the house? If so, you'll appreciate the 32-page DIY Handbook accompanying this issue of PM. Aside from the host of useful hints, it showcases a compelling variety of what we term "non-threatening" projects – that is, the sort of challenge that won't make you turn pale and reach for the Yellow Pages. A request: if you're inspired by our T-shirt cannon project and actually pluck up the nerve to build one, we would love to hear from you.



On to things digital. We recommend that you waste no time in downloading the *PM Daily* app and keep up with the latest events and discoveries via our daily sci-tech news service. Enter our regular competitions, browse our "Image of the Week" gallery – we've assembled some exquisite images from around the world – and watch videos to your heart's content. It's

available from the Nokia Ovi Store, iTunes App Store and Samsung App Store: search for "Popular Mechanics South Africa".

Latest news from the world of e-book readers is the arrival of an exciting new product from Amazon, plus a tweak that will turn your regular Nook Color into something quite different. For example, its improved functionality includes access to the many thousands of apps in Android Market, including *Angry Birds* – and therein lies a tale.

Although PM's staff were forewarned and forearmed, my own family enjoyed no such protection, and several of my nearest and dearest have been ensnared by the game's siren song. If this sounds painfully familiar, you might benefit from a YouTube visit: <http://bit.ly/eus9XO>. Hey, you might even start your own support group...

Alan Duggan

aland@ramsaymedia.co.za



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Sheer
Driving Pleasure



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SHEDDING LIGHT ON BULBS

Your piece on "light bulb wars" (October issue) is exactly the sort of article that we appreciate. It deals with something technical that confronts your readers on a daily basis. However, there was one notable omission from the article: the beautiful tungsten halogen lamps that are so popular in downlighters. These offer higher efficacy than standard incandescent bulbs and have a superb colour rendering index (CRI). It would have been nice to see those evaluated alongside the other lighting technologies.

In terms of CFL lighting, the trick to having a pleasant experience is much the same as it is with many other products: buy a quality unit that you like, and stick with it. The cheapest units on the market are often very shoddily made and fail prematurely. People buy them because of their low price, but end up replacing them more often. In general, the quality brand-name products will cost more but will also provide a better light for longer. Once you have found a brand that works for your application, stick with it and don't be tempted to save R5 on an inferior product.

LED lamp replacements are at a difficult stage in their development. There are increasing numbers of them on the market but they are not equal by a long stretch; this can cause quite a bit of confusion. To make matters worse, you cannot necessarily rely on brand names being better. Very often, LED lamps don't specify their light output, leaving the buyer to guess which one might be better. My advice is to do some research before buying: know how much light you actually need (look at the existing bulb for an indication), then look at the available bulbs to make sure they'll do the job. If energy efficiency is important to you, then calculate how many lumens per watt (lm/w) each bulb produces for an indication of which is best.

A while back, I stopped buying incandescent bulbs from choice. I am now using up my existing stocks of tungsten halogen and buying only new CFL and LED lamps. The quality of light in my home has improved and the power consumption has dropped. Win, win!

SAMUEL GINSBERG
VIA E-MAIL

Write to us, engage us in debate, and you stand to win a Canon PowerShot SX210 digital camera valued at R2 699. It comes with a 28 mm wide-angle lens and features 14x optical zoom, 14,1 megapixel resolution, DIGIC 4 processing, and high-quality 720p HD video – all in a sleek, pocket-friendly metal body. Other key features include an image stabiliser, a 7,6 cm LCD screen, face detection, and Servo AE for tracking moving subjects. For more information about the prize and other Canon products, visit www.cannon.co.za

Send your letter to: Popular Mechanics, PO Box 180, Howard Place 7450 or e-mail popularmechanics@ramsaymedia.co.za Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.

Online security: Round 3

Your "anti-hacking tips" (July and August issues) refer. Both options described by your readers will basically work, and your suggestion of 1Password from AgileBits is perfect. The problem with both of these file solutions is that the files are not encrypted, and the flash drive solution is an especially big security risk. These drives are very convenient but also easy to lose.

If this happens, you lose *all* your passwords, and at worst, the drive is picked up by someone who can use your passwords for evil purposes. Also, text files are easily corrupted by human error. I would avoid using either solution unless it's as a stopgap when you really need to save a password for a few hours. If you must do this, check out a tool called TrueCrypt (www.truecrypt.org) for encrypting your files.

The password-saving feature inside browsers isn't very secure, so please use it only for sites you don't care about, such as once-off games, etc – and *never* for sites where you enter your credit card details, or for banking or Web-based e-mail clients. The best policy is to turn off this option.

WERNER SCHIPPER

WERNER@CUBICSYSTEMS.CO.ZA

Editor's note: Werner's letter has been shortened. He goes on to describe his own, eminently sensible approach to online security in this blog post: www.aargh.co.za/blog/passwords

Hot-water energy losses

Your recent poll shows that readers are interested in saving electricity costs of hot water heating. Here are some ideas that will help. I recently constructed a solar panel that reticulates collected hot water to my cylinder with the use of a pump. To measure the efficiency of the system, I installed measuring devices at strategic points within the installation and observed a significant downstream loss of energy between the cylinder and the hot-water taps. I have since made changes to my plumbing system to improve its efficiency.

Previously, a 22 mm copper delivery pipe was run from the cylinder to a point above the furthest hot-water tap. At points along the pipe, connections were made to 15 mm pipes which led to individual taps. I guessed that this arrangement was a result of legacy regulatory requirements, at a time when hot water was fed by gravity to taps, the idea being that thicker pipes offered less resistance to water flow and hence produced a smaller pressure gradient between taps. The problem was that this necessitated the displacement of a large volume of cold water whenever a hot-water tap was used, incurring energy wastage. Copper pipes are good conductors

(and radiators) of heat. Energy loss is also incurred in heating the copper itself.

However, the heat loss may be substantially reduced with the use of plastic pipes. Reducing the diameter of the delivery pipe from 22 mm copper (0,9 mm wall) to a 15 mm plastic (2,3 mm wall) reduces the "dead" volume by a factor of 3,77. The surface area of the pipe, and hence the associated losses, are reduced by a factor of 1,46. Using 15 mm plastic pipe and a 200 kPa pressure regulator, I have not had a flow problem so far, even at a height of 2 m above the cylinder. Higher-pressure regulators can, however, be used to improve the flow with 600 kPa types being common. I used the 200 kPa type in order to protect instrumentation.

I installed a 1 m-long 22 mm plastic pipe manifold at the outlet of my cylinder. Each hot-water tap is individually connected to the manifold with a 15 mm plastic pipe, using the shortest route possible. Plastic pipe is easily bent to form large-radius bends; this should improve the flow characteristics when compared with the commonly used pipe bends.

These tweaks to the system, plus wrapping the hot-water cylinder in an insulating blanket, have resulted in a marked improvement in my domestic energy consumption. It's also nice to get hot water from the tap more quickly, and have the temperature stabilise sooner.

HOWARD BALL
HOUT BAY



Love you, but...

As always, I read my PM from cover to cover on the day I get it, even though I am in the middle of my matric exams. I would like to thank you for a great magazine; I've been enjoying it since April 2008 (just had a quick look at the neatly stacked pile on my table).

I was disappointed with the article, "What really happened in Area 51" (October issue), because – despite the promise in the headline – it ultimately told me nothing new about Area 51. All I got out of it was that Jacobsen wanted to make a little money, and that her

"source" was probably a bit delirious.

I loved your article about gyros ("Gyros go mainstream") but noticed that you state the Calidus 09's landing distance as 0 to 50 m, whereas their Web site gives it as 0 to 15 m. Typing error? Either way, I still can't get enough of your magazine, and the only reason I find mistakes is because you keep me so interested.

SYBRANDT COMBRINK
CAROLINA, MPUMALANGA

Editor's note: Thanks for the feedback, Sybrandt; we wouldn't have it any other way. Actually, the gyro's landing distance of 0-50 m was provided by the manufacturers themselves. As for Area 51, you'll be reassured to learn that not a single PM staffer has been abducted or inappropriately probed by aliens, Nazis or Stalinists (or so they claim).

Over-engineered? Perhaps not

Your article on aviation safety in September's "green" issue asks whether modern aircraft might be over-engineered. I would go the other way, citing technologies featured in the same issue that are *not* utilised in this "high tech" industry. I wonder why they had to search such a huge area for the wreckage of Air France Flight 447. They were so unsure of where to look that they disregarded the evidence when it was first spotted, attributing it to an oil spill from a passing ship.

Tracking our vehicles has been commonplace for years, personal tracking with a simple GPS-enabled smartphone is very popular, and as your magazine states, they are now even tracking rhino horns. Why then, when cheap satellite communication is readily available, are these hugely valuable flying tubes (not to mention their human cargoes) not sending their GPS positions back to their owners at least every 30 seconds?

It's ridiculous that air traffic control did not know there was a problem until the flight failed to report when crossing into Senegalese airspace. Information from the recently found black box indicates that the crew stalled the plane when the pitot tubes (used for speed indication) froze over, a problem previously known to Airbus. As a private pilot, I know that GPS signals are not considered sufficiently reliable as a primary aviation aid, but even my iPhone can show how fast one is going, and it does so in 3D. Why is the GPS not employed more effectively in mainstream aviation? Surely it would have been possible to narrow the search to a few square kilometres?

TREVOR D'OLIVEIRA
JOHANNESBURG




Let's play hardball with poachers


With regard to your article on rhino poaching ("War in the wild", September issue), I think the approach of the authorities to poachers and users of rhino horn is still too soft. Once you have stood beside the rotting carcass of the rhino you have fed for three months in captivity (to accustom it to the environment and edible plants), or have seen a rhino calf trying to help its dead mother get up, you will have no problem soaking rhino horn in poison and sending it off to China. Maybe they will get a wake-up call and stop destroying our natural heritage. Thank you for a great magazine.

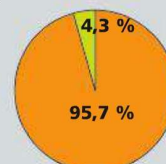
HARDIE BRINK
VIA E-MAIL PM

MONTHLY POLL

In the first half of 2011, poachers butchered 200 South African rhino for their horns. How should rhino poaching be dealt with?

 Poachers need to be dealt with severely and more backing needs to be given to anti-poaching groups like South Africa's national Rhino Task Force. 95,7%

 We need to legalise trade in the rhino horn. This will curb illegal rhino poaching once and for all. 4,3%



Conducted online at www.popularmechanics.co.za – visit PM's Web site to vote in our current poll.

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The image shows the rear passenger area of an Audi A8 L. The focus is on the tan leather-upholstered seats and the adjacent door panel. The door panel features a wood trim strip, a silver door handle, and a storage compartment. A black seatbelt is visible on the left. The background shows a bright, modern interior space with large windows.

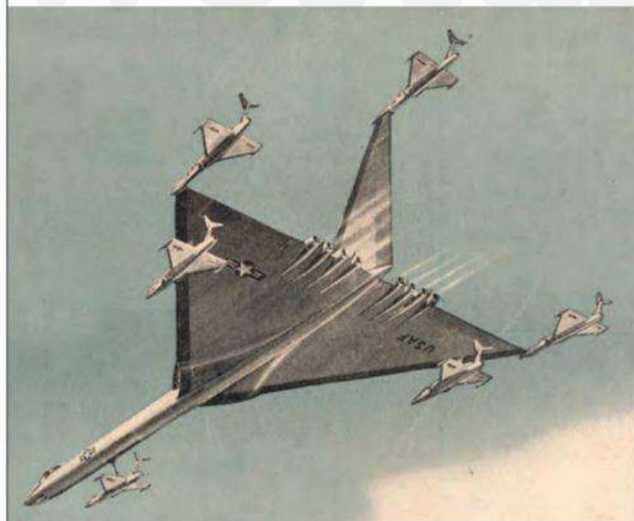
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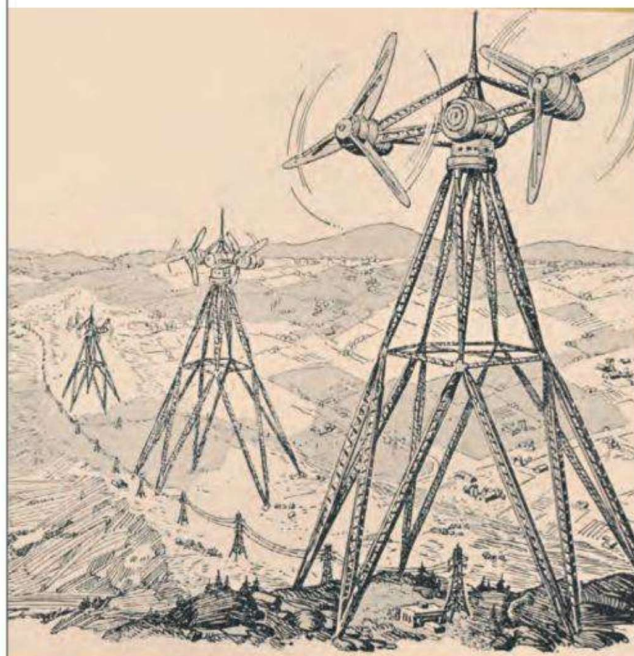
Official fuel consumption for the Audi A8 L range: From 7.8l / 100km - 12.4l / 100km. CO₂ emissions from 204g/km - 290g/km (combined). 5 year / 100 000km Audi Freeway Plan standard.

The figures given were calculated using specific operating conditions. These figures are indicative only and may vary according to the conditions under which the vehicle is operated.





1957 For this article, devoted to the “atomic airplane”, we assembled a panel of experts in the field of nuclear physics and aircraft design, asking them to share their thoughts on the future of nuclear-powered supersonic planes. Physicist Dr Lyle Borst of New York University figured it would take at least 10 years to put the first atom-powered aircraft in the air, and much longer – perhaps 30 years – to introduce a safe and economical commercial airliner. Sadly, 1987 has come and gone with nary a hint of such a machine.



1947 Sustainable energy generation in the form of wind turbines is nothing new, as our 64-year-old article attests. This unusual “aerogenerator” is the work of Percy Thomas, an engineer on the staff of the US Federal Power Commission, who envisaged a 145 m tower topped by two large propellers, each featuring 24 m-long blades. He estimated it would provide enough electricity to power 10 000 homes.



1967 PM writer Bill Hartford was given a rare opportunity to sample “tomorrow’s driving” in the form of a Plymouth (remember the brand?) equipped with a single aircraft-type control that combined accelerator, brakes and steering in one. Brainchild of a research team at Ohio State University, the car was designed as part of a long-term programme aimed at solving the problem of high-density traffic clogging America’s highways.

1937 The way we were. A driving class takes instruction at the Lane Technical High School in Chicago, raising hands to indicate their intention to stop. A similar programme operates at local driving schools, where student drivers learn that an extended middle finger indicates mild annoyance with blue-light motorcades. **PM**





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Technicians in France have finished a mosaic of 106 detectors, forming a billion-pixel digital camera for the European Space Agency's Gaia mission. Due to launch in 2013, Gaia will be stationed about 1,5 million km from Earth. There, its goal is to map a billion stars during a five-year survey. While the camera will be the largest

ever based in space, it is dwarfed by the 3 billion-pixel Large Synoptic Survey Telescope being built in northern Chile.



THE WORLD'S BIGGEST RAFT

A massive natural gas extracting, processing and storage facility anchored about 200 km off the coast of Australia

will become the largest floating structure in the world. Royal Dutch Shell will build a floating liquefied-natural-gas (LNG) unit stretching more than 480 m long and weighing more than 544 000 tons – six times heavier than the largest aircraft carriers. The facility will allow gas to be liquefied and shipped, rather than moved in pipelines.



UNDERWATER ACOUSTICS

Microphones pick up small vibrations created by pressure waves of sound, but under water, the pressure makes those sound waves so subtle that they're hard to detect. Naval engineers trying to create a versatile underwater microphone are also hampered by the huge range in pres-

sure. Stanford researchers created a hydrophone that, like the ears of orca whales, fills with water to equalise pressure. It also uses a laser system to detect vibrations at any depth.



VIDEO

> Watch a three-dimensional view of Gaia's telescope elements and focal plane on www.popularmechanics.co.za



ON THE WEB

> Read more about how the ultrasensitive undersea microphone works on www.popularmechanics.co.za

COSMIC DISCOVERY

Fumble and recovery



When a malfunctioning parachute caused the Genesis probe to crash in 2004, many thought that the mission – Nasa's first to return extraterrestrial material to Earth since Apollo's final moon landing in 1972 – ended in failure. Indeed, the crash in Utah destroyed most of the samples of solar wind (particles ejected into space from the Sun) collected 1,6 million km from Earth. But researchers salvaged particles from undamaged detectors and this year published their first analysis. The samples revealed that solar wind contains higher levels of the most common oxygen isotope than do Earth and other inner planets. This provides strong evidence that the planets and the Sun did not form from the same materials; the Sun was shining when Earth formed.

– ALEX HUTCHINSON



VIDEO

> Watch a video on www.popularmechanics.co.za of the entry and impact of the Genesis probe.



GENESIS RETURN CAPSULE

Weight: 225 kg
Diameter: 152 cm

MISSION

Duration:
1 127 days
Solar wind collection:
884 days
Distance travelled:
32 million km
Impact speed:
311 km/h

HINGED CLAMSHELL DOOR
JAMMED OPEN ON IMPACT

SAMPLE COLLECTORS
PROTECTED SOME SOLAR
WIND PARTICLES FOR
RETRIEVAL IN A
CLEAN ROOM

PARACHUTES
NEVER DEPLOYED BECAUSE
OF INCORRECTLY INSTALLED
ACCELEROMETERS



AMERICAN INFRASTRUCTURE



Prepping for bigger boats

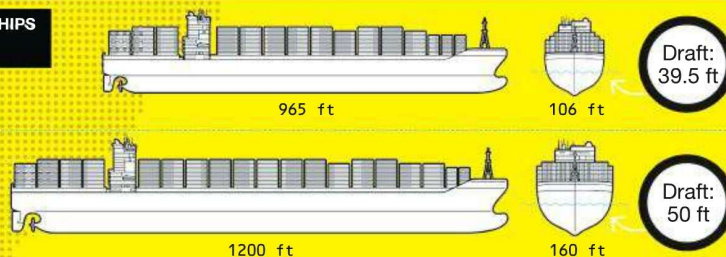
The operators of the Panama Canal are widening and deepening the waterway to allow larger ships to access the Atlantic and Pacific oceans, starting in 2014. Even as port operators prepare for the vessels (see below), work on other vital trade connections is lagging. Experts such as Paul Bingham, an economist with the transportation consulting firm Wilbur Smith Associates, say US road and rail networks are unprepared for the increase in commerce.

"The most critical problems are in urban areas near the ports," Bingham says. "These are dense regions without a lot of room to expand." Ships will unload twice as much cargo, causing logistical gridlock, says Johanna Mendelson Forman, senior associate with the Americas Programme at the Centre for Strategic and International Studies. "Railroads are at capacity in the US, and we have not invested what we need to be competitive." Bingham says the clock is ticking: "Three years is a blink of an eye. It's almost too late." – AMIR KHAN

GROWING CARGO SHIPS

Panamax

New Panamax



New spin on electric motors

Chemists at Tufts University's School of Arts and Sciences in the US have developed the world's first single-molecule electric motor, a development that may potentially create a new class of devices that could be used in applications ranging from medicine to engineering.

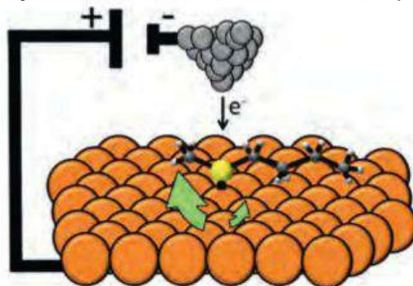
In research published online in *Nature Nanotechnology*, the Tufts team reports an electric motor that measures a mere 1 nanometre across – groundbreaking work considering that the current world record is a 200-nanometre motor. To give this perspective, a single strand of human hair is about 60 000 nanometres wide.

Says Dr Charles Sykes, associate professor of chemistry at Tufts and senior author on the paper:

"There has been significant progress in the construction of molecular motors powered by light and by chemical reactions, but this is the first time that electrically-driven molecular motors have been demonstrated, despite a few theoretical proposals. We have been able to show that you can provide electricity to a single molecule and get it to do something that is not just random."

Sykes and his colleagues were able to control a molecular motor with electricity by using a state of the art, low-temperature scanning tunnelling microscope, one of about only 100 in the United States. It uses electrons instead of light to "see" molecules.

Source: Tufts University



The world's first single-molecule electric motor may potentially create a new class of devices in applications ranging from medicine to engineering.

DIGITAL FUTURE

Life beyond flash?

A replacement for a computer's flash memory is closer, thanks to a new advance by IBM. Phase-change memory (PCM) relies on specialised material that transforms from a highly organised crystalline structure to an amorphous form when voltage is applied. Like flash, PCM involves no moving parts and retains information even when the power is turned off. But it can also read and write data 100 times faster than flash and can endure millions of times more read-write cycles. The IBM research shows that a multi-level form of PCM can store information without errors for at least five months, a significant improvement upon previous versions.

– ALEX HUTCHINSON

PAST LIVES

Did dino blood run hot or cold?



→ A team of researchers led by Caltech has developed a new technique to help settle the long-standing debate about the body temperature of dinosaurs. The team analysed the concentrations of carbon-13 and oxygen-18 isotopes in 11 dino teeth dug up in the western US and Tanzania. Since those two isotopes clump in a predictable way depending on temperature, the researchers were able to

conclude that Brachiosaurus had a body temperature within a degree or two of 38,2 degrees Celsius, and Camarasaurus, 35,7 degrees. While those temperatures are similar to that of humans today, it doesn't necessarily mean dinos were warm-blooded: their large size may have allowed them to conserve heat efficiently. The new data will have to be incorporated into dinosaur physiological models, along with factors such as the spacing between fossilised tracks, that offer clues about the speed of dinosaur metabolism. – ALEX HUTCHINSON



ON THE WEB

> Visit www.popularmechanics.co.za to learn more about the clumped-isotope technique used to determine accurate body temperatures of dinosaurs

MANNED SPACEFLIGHTS



Nasa's new space plane

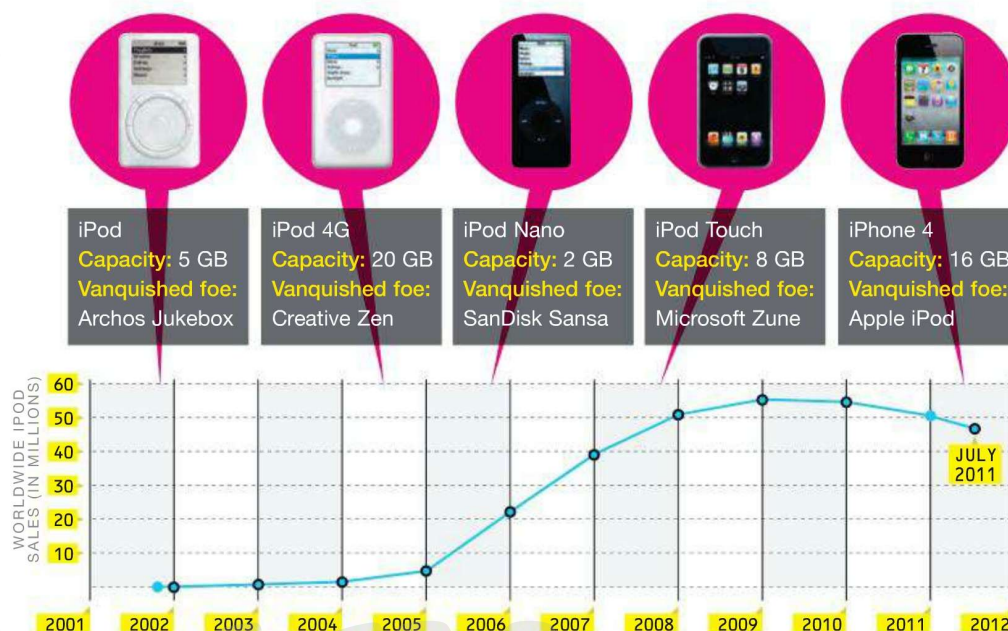
→ Sierra Nevada Corp. received \$80 million this year to develop its *Dream Chaser* space plane (above), aiming for a 2015 test flight. The money is part of Nasa's Commercial Crew Development programme, which is funding research on a manned spacecraft that would replace the space shuttle. *Dream Chaser* is the only space plane in the CCD programme; two craft in development are capsules, and the third would take off and land vertically. *Dream Chaser* would launch atop an Atlas V rocket, dock with the International Space Station and land on a runway. – JOE PAPPALARDO

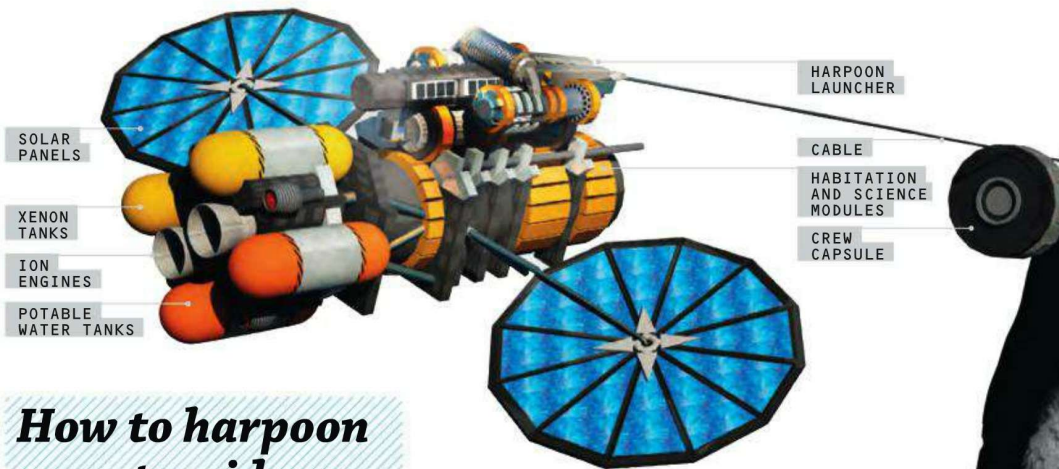
THE IPOD DECADE

CHANGE OF TUNES

→ On 23 October 2001, Apple introduced its first portable music player, the iPod, to mixed reviews. Ten years and 315 million sales later, the iPod's influence on consumer technology is hard to overstate. But the iPod era is coming to a close. Smartphones with music and video players are replacing the iPod, along with the category it helped create.

– JOHN HERRMAN



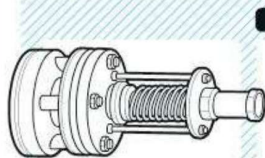


How to harpoon an asteroid

➔ Nasa plans to send astronauts to an unspecified asteroid by 2025 – but how the spacecraft carrying them will land is still an open question; an asteroid's gravity is too weak to hold a lander. Instead, astronauts will have to grapple the asteroid to secure their ship to its surface.

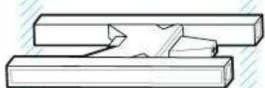
Inspired by fishermen, hikers and mountaineers, researchers at MIT are investigating techniques for shooting projectiles into the rock to stabilise spacecraft with cables. A capsule could travel down the tether on mechanised rollers or fly around the entire asteroid to wrap it with cable, providing astronauts with downward pressure that would serve as artificial gravity.

Projectiles would need to be tailor-made for each target (see below). "Some asteroids might have a metallic core, and trying to anchor to them would be like banging a nail into an anvil," says Jeffrey Hoffman, a professor of aeronautics and astronautics at MIT and a former astronaut. "Others may just be a rubble pile, which would be like trying to pitch a tent on a snowfield." Astronauts could also use these docking techniques on the moons of Mars – which the Obama administration has cited as possible destinations – because of their similarly weak surface gravity. – ALYSON SHEPPARD

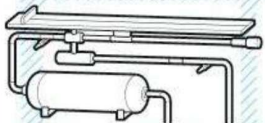


LAUNCHERS

Spring-loaded gun ➔ Simple and lightweight, this launcher could repeatedly shoot a projectile without using an energy source.



Electromagnetic launcher ➔ Two metal rails flank the projectile, zapping it with a large electric current to cause high acceleration.



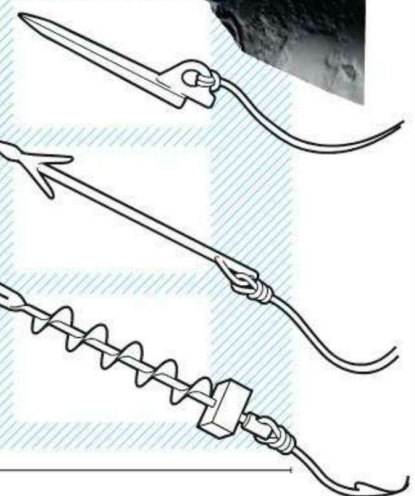
Steam catapult ➔ Steam pressure drives a shuttle carrying the projectile. The shuttle shoots to the end of the rail and propels the projectile into space.

PROJECTILES

Piton ➔ Made of steel alloy and aimed at surface cracks, pitons are well-suited for asteroids with metal cores.

Harpoon ➔ Barbs on the harpoon open once it sinks into rock, preventing the anchor from coming loose.

Corkscrew ➔ After sinking the tip into its target, a motor twists the corkscrew to secure it in granular rubble.



Why not send robots to an asteroid?

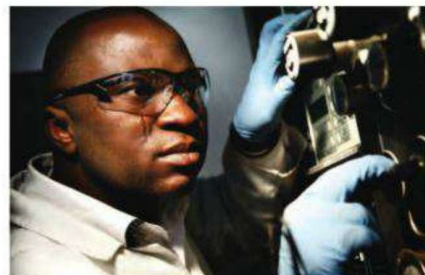
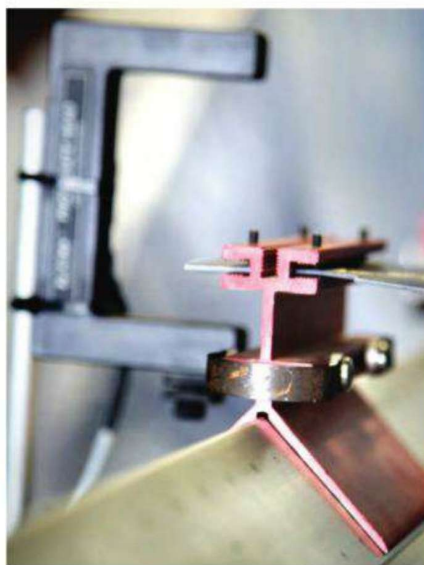
People can adapt to unplanned situations much better than robotic systems can. The whole environment of asteroids is still unknown, so the more flexibility we have with anchoring equipment, the more likely we'll be successful. We'll take as many different methods as possible and let the astronauts try them out, make adjustments on the spot, and see which ones work best.

– JEFFREY HOFFMAN, professor of aeronautics and astronautics at MIT and five-time space shuttle astronaut

“Without inspiration the best powers of the mind remain dormant. There is a fuel in us that needs to be ignited with sparks – which in this case is education.”

– Prof Ian Alderton, Acting Executive Dean

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Picture by iStockphoto/Randall Schwanke

TACKLING THE DESIGNER-DRUG MIMICS

Scientists have reported development of much-needed new tests to help cope with a wave of deaths, emergency room visits and other problems from a new genre of designer drugs sold legally in stores and online that mimic the effects of cocaine, ecstasy and marijuana. They spoke at the 242nd National Meeting and Exposition of the American Chemical Society (ACS).

The reports focus on drugs sold as "bath salts", "plant food", "incense" and other products with colourful names such as "Ivory Wave", "Red Dove" and "legal marijuana". They provide users with a high, but many have not yet been made illegal and are undetectable with current drug tests. In one presentation on these "legal highs", a UK researcher reported a new method to trace the source of the substances in "bath salts".

Dr Oliver Sutcliffe and his collaborators reported the successful use of a method called isotope ratio mass spectrometry (IRMS) to determine who is making bath salts – drugs that can cause euphoria, paranoia, anxiety and hallucinations when snorted, smoked or injected – and which chemical companies supplied the raw materials.

"Bath salts" first garnered major media attention in the UK in early 2010, later becoming a problem in the US, too. These products are not in the supermarket soap aisle; they are sold on the Internet, on the street and in stores that sell drug paraphernalia.

Source: American Chemical Society

Sun-powered hydrogen extractor

Scientists from the University of Kentucky and the University of Louisville have determined that an inexpensive semiconductor material can be "tweaked" to generate hydrogen from water using sunlight.

The researchers say their findings are a triumph for computational sciences, one that could potentially have profound implications for the future of solar energy. Using state-of-the-art theoretical computations, the team demonstrated that an alloy formed by a 2 per cent substitution of antimony in gallium nitride has the right electrical properties to enable solar light energy

to split water molecules into hydrogen and oxygen, a process known as photo-electrochemical (PEC) water splitting.

When the alloy is immersed in water and exposed to sunlight, the chemical bond between the hydrogen and oxygen molecules in water is broken. The hydrogen can then be collected.

Hydrogen has long been touted as a likely key component in the transition to cleaner energy sources. It can be used in fuel cells to generate electricity, burned to produce heat, and utilised in internal-combustion engines to power vehicles. When combusted, hydrogen

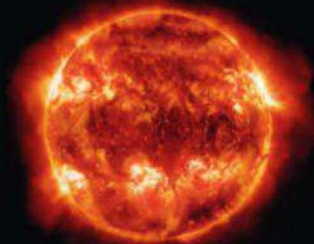
combines with oxygen to form water vapour as its only waste product. Hydrogen also has wide-ranging applications in science and industry.

Because pure hydrogen gas is not found in free abundance on Earth, it must be manufactured by unlocking it from other compounds. Thus, hydrogen is not considered an energy source, but rather an "energy carrier". Currently, it takes a large amount of electricity to generate hydrogen by water splitting. As a consequence, most of the hydrogen manufactured today is derived from non-renewable sources such as

coal and natural gas.

The research team says the GaN-Sb alloy has the potential to convert solar energy into an economical, carbon-free source for hydrogen. Once it becomes widely available, it could conceivably be used to make zero-emissions fuel for powering homes and cars and to heat homes.

Source: Universities of Kentucky and Louisville



THE ART OF PHYSICS

CONSTANT CHANGE

Every four years, an international group called the Committee on Data for Science and Technology makes public its accepted values for the fundamental constants of Nature. That way, for example, every physicist studying quantum mechanics is using the same figure for the size of a proton (right). The committee adjusts these figures in response to more accurate measurements. — JOE PAPPALARDO

$$r_p = 0.8768(69) \text{ fm}$$

PROTON RADIUS

QUANTIFIES THE SIZE OF A FUNDAMENTAL PARTICLE

Recent experiments led the group to recommend a slight increase in the proton's size. This recommendation dismisses as "inconsistent" the results of other recent research, which used an exotic form of hydrogen and suggested that the proton size was smaller.

PLANCK CONSTANT

DEFINES THE SIZE OF THE SMALLEST ENERGIES OF LIGHT PACKETS

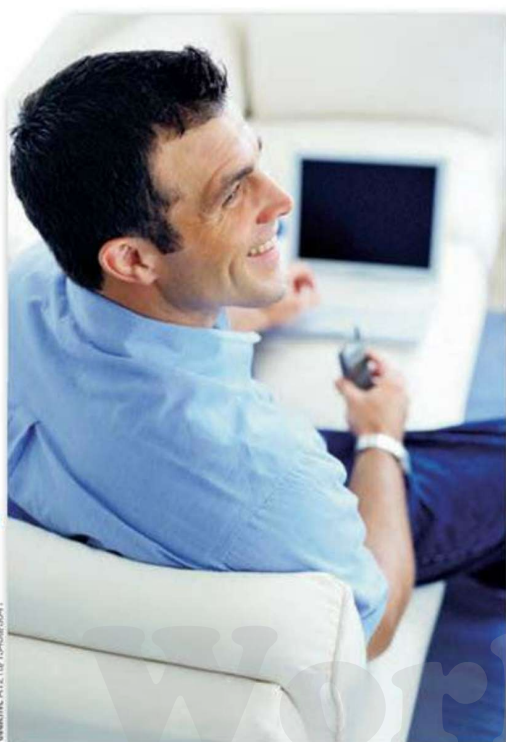
Two ways of calculating this constant – one that counts silicon atoms in a pure crystal and another that compares electrical and mechanical power – come up with slightly different values. The new figure reflects the fact that the two values are converging.

CONSTANT OF GRAVITATION

DICTATES THE STRENGTH OF NEWTONIAN GRAVITY

New ways to measure gravity have determined that this constant is slightly less powerful. The value appears in both Einstein's theory of relativity and Newton's law of universal gravitation, but the change does not greatly influence either theory. **PM**

People in the know, know



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HP20

(Uses 4 x AA batteries)

ANSI/FSC	Lighting Mode				Flashing Mode		
	Turbo	High	Mid	Low	Strobe	Slow Flash	SOS
OUTPUT	230Lm	125Lm	51Lm	6Lm	230Lm	51Lm	51Lm
RUNTIME	3h29	8h24	24h	296h			
DISTANCE	167m						
IMPACT RESISTANT	1.5m						



TK70

(Uses 4 x D-Cell batteries)

ANSI/FSC	Lighting Mode				Flashing Mode	
	Turbo	High	Mid	Low	Strobe	SOS
OUTPUT	2200Lm	930Lm	300Lm	20Lm	2200Lm	930Lm
RUNTIME	1h50	4h30	15h	168h		
DISTANCE	720m					
IMPACT RESISTANT	1m					



TK41

(Uses 8 x AA batteries)

ANSI/FSC	Lighting Mode				Flashing Mode	
	Turbo	High	Mid	Low	Strobe	SOS
OUTPUT	800Lm	335Lm	108Lm	10Lm	800Lm	108Lm
RUNTIME	2h10	7h15	27h	240h		
DISTANCE	472m					
IMPACT RESISTANT	1.2m					

E15

(Uses 1 x CR123A battery)

ANSI/FSC	High	Mid	Low
OUTPUT	10Lm	108Lm	10Lm
RUNTIME	7h15	27h	240h
DISTANCE	89m		
IMPACT RESISTANT	1m		



These Fenix torches are all digitally regulated to maintain more consistent output over the life of the batteries. They are manufactured from aircraft grade aluminium with type III hard anodized finish and are waterproof to IPX-8 standard (submerged in 2 meters of water for 30 minutes). A key feature is that they always turn on in the last selected mode.

Notice: The above-mentioned parameters are approximate and may vary between flashlights, batteries and environments.

PICQUIC

SINCE 1988

Picquics are made in Canada with a lifetime warranty against manufacturers defects on the well balanced handles with great grip feel for best torque, using strong, solid polymer handles and heavy duty high force magnetic bit holder shanks. These screwdriver shanks have hex bolsters to permit adding even more torque when tightening or loosening screws. They are no slouches when put to hard work! Powerbits are made of extra-hard steel and can be used in power drivers too!

Teeny Turner



The Picquic Teeny Turner screwdriver is a small little powerhouse with quality packed-in like no other small driver. Use the Teeny Turner to service cell phones, toys, computer components, eyeglasses and sunglasses. The Teeny Turner uses bits that are 3/16" hex and 25mm long and is available in assorted colours.

Stubby



The Picquic Stubby is the model to choose for those tight spaces where a standard or compact driver just won't fit. The Stubby uses bits that are 1/4" hex and 37mm long and is available in assorted colours.

Dash 7



The Picquic Dash 7 is the little brother to the famous and popular SixPac Plus. They both share the same handle thickness, the same shaft length and diameter and the colours. The Dash 7 is a shorter version for smaller work spaces, having a shorter handle and 2" power-rated bits instead and the smaller size is easier to stow in glove box or small tool box. The Dash 7 uses 1/4" powerbits that are 50mm long and is available in assorted colours.

Multique



The Picquic Multique is "strong enough for a man, smart enough for a woman". It is a slim version of the SixPac Plus: Slimmer, shorter handles for smaller hands and slimmer, shorter bits. Smaller size is easier to stow in glove box or small toolbox. The Multique uses 3/16" bits that are 63mm long and is available in assorted colours.

Super 8 Plus



The Picquic Super 8 Plus screwdriver features the Thru-Handle instant bit change system, making bit changes very quick and easy plus includes 2 nut drivers, reversible, incorporated into the bolstered shaft. In addition to the most common bits, the centre portion of the shaft removes and reverses for the 1/4" and 5/16" nut driver sockets. The Super 8 Plus uses 1/4" powerbits that are 75mm long.

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DIY FLIGHT

It's good to be an amateur aircraft designer in the United States. Engineering software is sold on the shelves, American airspace is the most permissive in the world, and hordes of fellow tinkerers are on hand to help build. There's no greater thrill than constructing your own plane — except flying it safely.

BY JEFF WISE



Photograph by Jake Stangel

It was a warm, clear morning in West Texas, a fine day for flying as Mark Stull

cruised low over rocky, cactus-filled rangeland. With a popping sound, the control stick suddenly jerked and the plane's nose tipped down. Stull instinctively hauled back on the stick and the nose came up, but he could tell something was terribly wrong by the plane's lack of responsiveness. He had to hold the stick almost all the way back just to maintain level flight. Even though he knew the craft's every wire and strut – he had built the aeroplane from scratch, after all – Stull didn't know what the problem could be. "I couldn't think of anything



DAVID ROSE IS THE RAREST KIND OF AVIATION ENTHUSIAST – HE DESIGNS, CONSTRUCTS AND FLIES HIS OWN HIGH-SPEED AEROPLANES. HE'S BUILDING THIS CRAFT, THE RP-4, TO BEAT A 22-YEAR-OLD SPEED RECORD OF 850 KM/H.

that would suddenly slack the 'up' elevator cable like that without letting go completely," he recalls.

Nerves on edge, Stull nursed the stricken craft 13 kilometres back to the airfield, landed and jumped out to examine his aeroplane. A clamp holding the pulleys that fed a cable to the plane's tail had broken and was barely hanging on, like a fingernail on a cliff. "If I'd hit the slightest bit of turbulence, it would have popped off," Stull says. "I would have lost control, and I'd be dead."

That was the first time Stull escaped a potentially fatal accident in one of his homebuilt planes. But it wasn't the last. There was the time an engine mount failed in flight. And there was the time his muffler fell off and hit the spinning propeller. But as far as Stull is concerned, a few mishaps are all part of the game.

The 59-year-old former motor mechanic belongs to a tiny subculture that takes up the ultimate engineering challenge: designing an aeroplane, building it from parts and wagering lives on its airworthiness by flying the creation. "It's a borderline obsession for some people," says Jake Crause, administrator of homebuiltaeroplanes.com, the community's online nexus.

No other country has produced a more storied tradition of aeronautical innovation than the United States, and the

vibrancy of the homebuilder community is an extreme testament to this legacy.

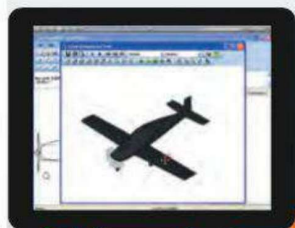
This kind of creative aeronautics has never been safer or easier to pursue. Inexpensive computer-aided design (CAD) programs can configure airframes, and off-the-shelf flight simulations can verify the blueprints before a designer cuts metal. These programs have helped usher in safe, successful aircraft that can outperform professional models, win races and catch the attention of admirers at air shows.

Still, Stull prefers the intimacy of old-fashioned ways, using pencil and paper to sketch plans that please his eye. Even load calculations can be a matter of intuition. "I have a knack for visualising loads on structural parts," Stull says. "I calculate when necessary. So you just build it robust. But not too robust."

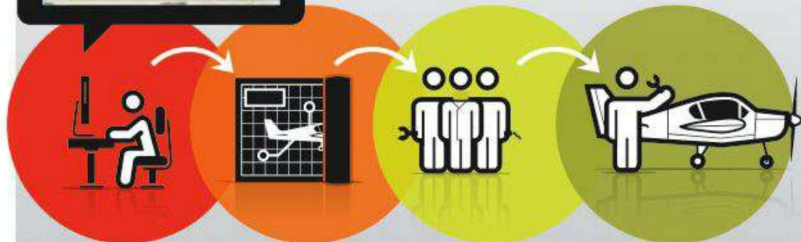
Homebuilt-aeroplane makers are actually a subculture within a subculture. Of the 23 000 amateur-built aircraft in the US, all but a minority were built from professional designs or assembled from kits. Only a handful of builders finish and fly the planes they design – and with good reason. An aeroplane is a complex piece of engineering. A design that is 99,9 per cent perfect could still harbour a fatal flaw. "All it takes is one little thing," says Martin Hollmann, an aeronautical engineer who conducts seminars on aircraft design. "All you need is the bolt to break on the elevator and you can kiss your ass goodbye."

According to the US National Transportation Safety Board, homebuilt aircraft are three times as likely to wind up in a fatal accident as industrially manufactured light aircraft. The agency doesn't keep separate records for planes designed by hobbyists, but the accident rate for those is likely even worse. One of the ways that pilots get into trouble is by improvising tweaks or substitutions to established plans. John Denver, for instance, died in 1997 while flying a kit plane its builder had modified with a relocated fuel valve that Denver apparently had trouble reaching after one of his tanks ran dry. With amateur-designed homebuilds, the problem is even worse: the planes are improvised from tip to tail.

AVIATION AMBITION: BUILD IT YOURSELF



Want to take to the skies in a plane that you've designed and built yourself? You've got a long climb ahead of you, but some inexpensive tools and a supportive community of like-minded pilots will help you on your way.



1. Build virtually first

To test how well your ideas will work in practice, buy a copy of X-Plane, a program that lets you design a plane and then fly it over realistic landscapes. Homebuilt designer David Rose uses the program in conjunction with the CAD program AeroplanerPDQ. Total cost, \$198 (SA equivalent about R1 400). "With those two programs," he says, "I can do everything a \$30 000 design suite can do."

2. Design the structure

To configure actual parts and solicit advice on how to put them together, crack open Martin Hollmann's book *Modern Aircraft Design*. Hollmann also offers design classes at fly-ins, and structural consulting for intrepid aeroplane homebuilders (aircraftdesigns.com).

3. Get support

The Experimental Aircraft Association, an organisation of aviation enthusiasts, has branches all over the world. Local members can offer encouragement, advise you on technical issues and even help do the work. "A lot of people are willing to volunteer their time just to be involved in a project," Rose says.

4. Get to work

People who build planes of their own design tend to be retired folk with a lot of energy. "It's going to take at least two years of full-time work, including weekends," Hollmann says. "And that's if you do everything right."

COUNTER-
ROTATING
CARBON-FIBRE
PROPELLERS

TWIN 2 000-kW
DART V8
ENGINES
(ONE SHOWN)

Jake Stangel

1

NAME:
DAVID ROSE

LOCATION:
SAN DIEGO

PLANE: *RP-4*

David Rose obviously built the overpowered RP-4 for speed. The experimental counter-rotating propellers, inspired by a Nasa project, run at an impressive 4 800 r/min. Rose can connect both propellers directly to their

engines without heavy reduction gearing. The props can change pitch for maximum efficiency at any speed. "It's a drag-racer frame with skin on it to keep the wind out," says Jerry Baer, a former pilot who helped Rose build RP-4.

PLANES MADE TO ORDER:

SOME ASSEMBLY REQUIRED

Not totally committed to building an aeroplane from scratch? Consider buying a kit plane instead. Many manufacturers produce partially assembled airframes. Some companies even allow you to come to their factory and assemble the kit with the help of employees, potentially cutting the build time from months to weeks.

1. Shop around

Before you jump in, make sure the plane you're going to build is the right one for you. Read up on the various available models. The more successful designs have active online forums where builders can share their expertise. "Don't just base your decision on what a plane looks like," says Andy Chiavetta, a crew chief for Reno air-races pilot Darryl Greenamyer. "Talk to people who've flown them."

2. Dabble

There are three main construction materials used in homebuilt planes: wood, metal and composite. Each has its own advantages and requires different aptitudes. Try them out to determine which suits you best. Every year the massive EAA AirVenture convention in Oshkosh, Wisconsin, holds hands-on workshops where would-be homebuilders can try different techniques.

3. Start small

Manufacturers such as Van's Aircraft sell partial kits. Buy the tail, and if building it is too hard or unsatisfying, you can rethink your options without wasting months of work and thousands of rand.

4. Be realistic

Even if you're involved in a builder-assist programme, constructing a functioning aircraft requires a serious time commitment. "There are an awful lot of kit planes out there that get started and are never finished," Chiavetta says.

And that challenge is the real joy of building a plane from scratch rather than assembling a kit plane from a vendor. "I started with a piece of paper, and now I have an aeroplane," says air-race team crew chief Andy Chiavetta, who recently flew his self-designed plane after eight years of construction. "That's extremely thrilling."

An amateur aircraft designer can tailor a plane to fit his or her precise requirements, no matter how outlandish. Take David Rose. Inside his hangar at Montgomery Field in San Diego, this former airline pilot is building a machine that he hopes will earn him aeronautical immortality. If all goes according to plan, a thunderously overpowered racing machine called RP-4 will reach a straight and level speed in excess of 850 km/h and become the world's fastest piston-driven plane. The 22-year-old record is held by a modified World War II-era Grumman F8F Bearcat.

Rose has been obsessed with speed all his life. In his teens, he built drag racers and started a weekly race meet in Petersburg, Virginia, near his home town. Then he joined the Air Force, where, impatient to break the sound barrier (1 224 km/h at sea level), he took an F-86 to 9 000 metres and then dived straight down on full afterburner. In civilian life, he flew (more responsibly) passenger jets for American Airlines.

In 1990, Rose found inspiration at the National Championship Air Races in Reno, Nevada, where souped-up planes tear around a closed circuit 15 metres off the ground at speeds exceeding 800 km/h. He bought a used Pitts Special biplane and won a trophy with it in 1992 – and then decided he could do better. Using off-the-shelf engineering software, he designed his own biplane.

No big deal, Rose says: "You just crack the books and buy some computer programs." With the help of former airline pilot Jerry Baer and local mechanic Eric Hereth, Rose built the plane in his hangar in 10 months. Powered by a 170 kW engine, it clocked 360 km/h around the Reno circuit in 2002 and won Rose the Biplane Gold category four times.

His RP-4 project is another beast entirely. Inside the cowlings sit two engines, both 4 340 kW Dart V8 "Big M" aftermarket drag-racing blocks, 9.8 litres each, one mounted in front of the other. The massive engines suck 110-octane racing fuel at 450 litres per hour. The exhaust stack produces 1 330 newtons of thrust – enough, Rose says, that "we could fly the plane on the exhaust alone".

Instead of linking directly to a single prop, the driveshafts turn a gearbox connected to a pair of counter-rotating propellers, 60-cm-long carbon-fibre blades. The experimental design, which offers greater efficiency than conventional props, was developed by Nasa engineers for the rigours of high-Mach flight. At full throttle, the propeller's tips break the speed of sound.

Rose and Hereth are obsessed with their high-speed project and



In 1989, Cory Bird was a workshop fabricator at Scaled Composites, famed aviation designer Burt Rutan's company, when he decided to use his knowledge of composite construction to build aeronautical art. "I wanted to show what I could do," he

says. Over the next 14 years he conceived and created a two-seat aeroplane he called Symmetry. The sleek aircraft can reach 456 km/h at 3 000 r/min. The labour of love proved so exquisite that it won a Grand Champion prize at the Experimental Aircraft

Association's big air show in Oshkosh, Wisconsin. Today, the 53-year-old Bird, now a project manager at Scaled, is hard at work on another design for a plane that will carry two and land on shorter airstrips than Symmetry.

NAME:
CORY BIRD
•
LOCATION:
MOJAVE, CALIFORNIA.
•
PLANE:
SYMMETRY

2



LANDING
GEAR:
ONLY THE
TAIL WHEEL
RETRACTS.

ENGINE:
150-KW
LYCOMING



ENGINE:
19 KW
KAWASAKI
WITH A
3-TO-1 BELT
REDUCTION
DRIVE

CLIMB RATE:
400 FEET PER
MINUTE

3

NAME:
MARK STULL
•
LOCATION:
CHRISTOVAL, TEXAS
•
PLANE:
LUCKY STARS

expect other people to feel the same; the odder the construction, the more the builders want to show it off.

Outside the open hangar doors, a sunset is turning the underbelly of the quilted cumulus Barbie-pink, and the breeze carries the sweet tang of eucalyptus. Rose runs an appreciative hand along the boxy skeleton of 4130 moly-chrome tubing – another of the craft's unusual features.

Most modern planes have monocoque construction, with the metal or composite skin providing much of the structural strength. RP-4 is built more like a skyscraper, with an internal truss bearing all the major stresses.

This structure is designed to survive an impact of nearly 500 km/h, Rose says.

"If the angle is less than 10 degrees," Hereth adds.

Mark Stull sits on a folding chair under the wing of his ring-tailed yellow ultralight, Lucky Stars. Similarly fanciful flying machines are lined up in rows on either side of him, and behind his back a plastic mesh fence marks the edge of a grass runway upon which a dazzlingly eclectic procession of aircraft have been taking off: powered parachutes, flying boats and even a miniature P-51 Mustang.

Wiry and compact, with close-cropped hair, Stull has an angular face that seems as if it were designed for minimum wind resistance in an open-frame flying machine. He has travelled halfway across the country to attend one of the premier events on the homebuilder's calendar, a Florida fly-in called Sun 'n Fun. One week every spring, aerobatic flight teams, owners of antique military aircraft and all manner of merchandise dealers converge amid throngs of aviation enthusiasts.

There are not many people who build their own planes, but they command outside respect in the aviation community. They may not all have technical backgrounds, but they like to work with their hands and are confident of their skills. Above all, they are maniacally determined and persistent. "I don't think they could keep themselves from doing it even if they tried," HomeBuiltAeroplanes' Crause says.

Their unique levels of self-motivation mean that builders like Rose and Stull tend to be solitary, beaver away on their creations alone or with a small number of friends. But when they need help, there's a

Homebuilt aeroplane pilots are motivated by more than aerodynamics. Mark Stull built Lucky Stars with a 1,4-metre ring tail. It took some clever engineering – and some hair-raising test flights – to make it work. Stull added a hydraulic damper to ensure that the tail didn't swing too far to the side, and balanced the tail by adding weights to the ring. He then moved the seat forward to maintain the craft's centre of gravity.

Bill Yeates

SWITCH HEADS

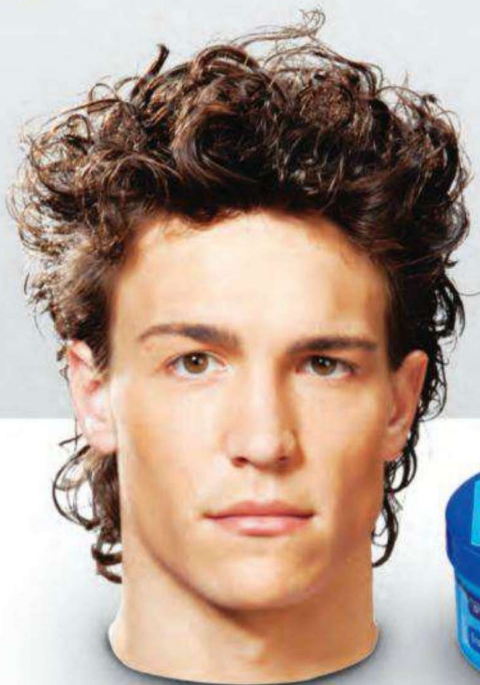
WITH TWO NEW EXTREME MATT PRODUCTS FOR LONGER HAIR



EXTREME
STYLE

[mattRange]

These awesome new products add to the existing VO5 Extreme Style mattRange. The unique, no-shine matt effect will have the ladies running their fingers through your sexy styles faster than you can say "grease-free". Check out how to use the new products.



[roughItUp Putty]

- IDEAL FOR LONG HAIR
- ANTI FLUFF
- LASTING, PLAYFUL TEXTURE
- SLEPT IN, CASUAL LOOK
- NON-GUNKY
- NO SHINE

- 1 Scoop a small amount of roughItUp Putty and rub it between your hands
- 2 Run it through your damp or dry hair, pulling through your fingers to spread evenly
- 3 Rough your hair up with your palms for a relaxed texture and funk up the front to form a quiff
- 4 With a little more roughItUp Putty pull chunks of your quiff upwards and piece out the back and sides.



NEW

[control-It Creme]

- IDEAL FOR LONG HAIR
- NON-GUNKY
- USE WITH DRYERS AND STRAIGHTENERS
- TAMES FLUFF
- NO SHINE
- LASTING, TOUCHABLE HOLD

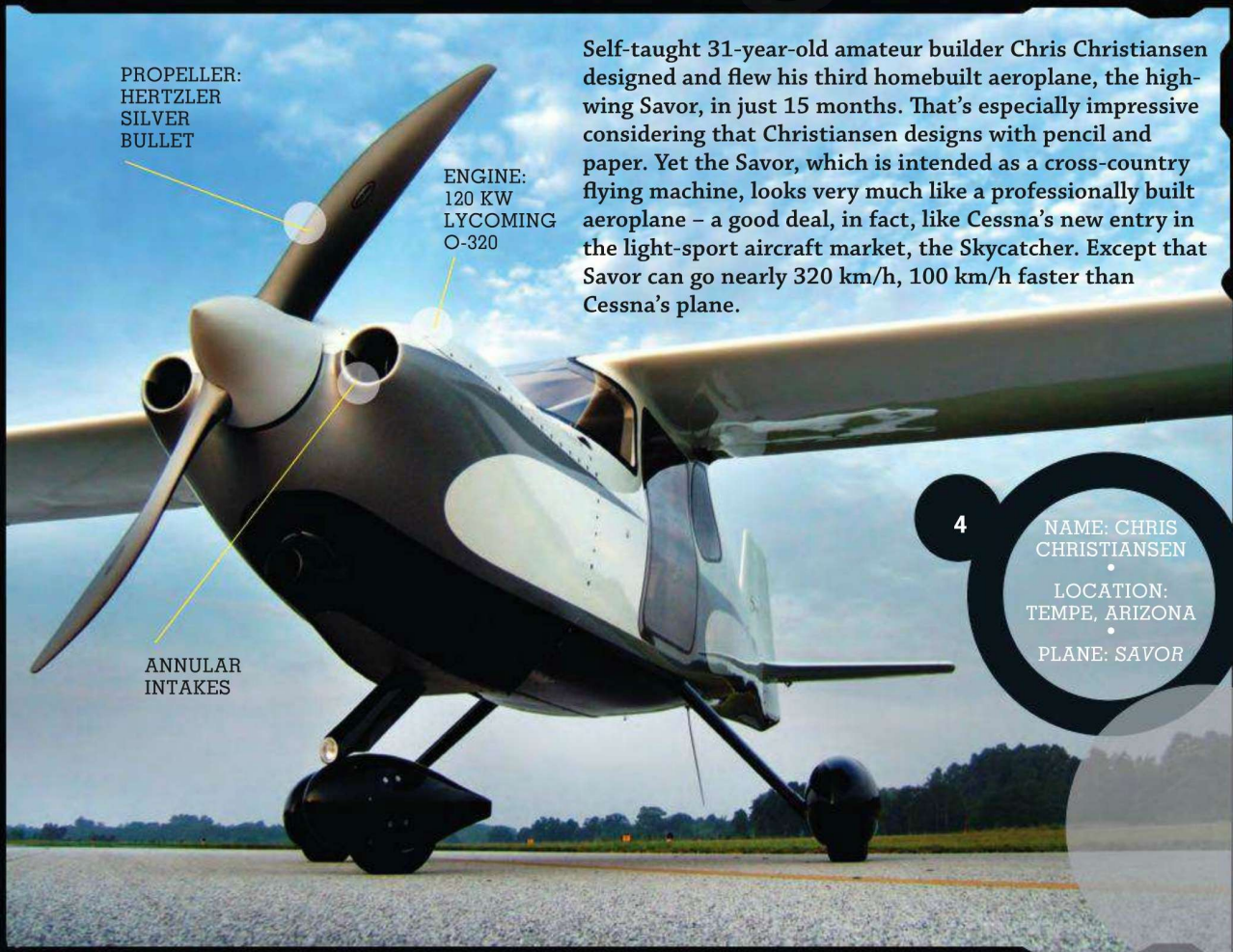
- 1 Squeeze a pump of control-It Creme in the palm of your hands and rub together
- 2 Smooth your hair to one side with your palms, shaping your fringe across your forehead with your fingers
- 3 For an edgier look, piece out random chunks all over, pulling them with your fingers then smooth over your ears at the sides.



NEW



Visit facebook.com/VO5SA



Chris Christiansen

large, very supportive network of builders spread across the country. “It’s a team effort,” Hollmann says. “We try to stick together and help each other.”

An event like Sun ‘n Fun is one of the few occasions when the tribe gets to connect face to face, and the sense of communion can be electrifying: For once, these men are surrounded by human beings who not only understand what they’re talking about, but actually care. A reporter from a kit-building magazine stops by and sits next to Stull. “What was the first flight like?” he asks.

“I almost crashed four times,” Stull replies. He explains that he had built the control stick so that it hinged at the top instead of the bottom. “It was indescribable how confusing it was,” he says. “I did a hop and almost crashed, and I tried again.”

In the end, Stull wound up rebuilding the control system along more conventional lines. He is forever tinkering, reconfiguring and trying new ideas. “I can build a plane in three months,” he says, “but it takes me up to a month to adjust it.”

The importance of strong construction skills became apparent at Sun ‘n Fun: the day before, a tornado trashed half the planes in this section of the airfield. Some were crumpled into balls of fabric and mangled spars. Lucky Stars made it through almost intact – the main boom holding its tail in place snapped, grounding it.

Later that afternoon, Stull wanders over to chat with ultralight

pioneer and fellow homebuilder John Moody, who is reclining on a lawn chair next to a biplane without a tail or fuselage.

Stull wonders aloud if the ultralight innovator might be asleep, but Moody jumps up, and he and Stull fall into a conversation about the pros and cons of Lucky Stars’ ring-shaped tail. “It’s cool,” Moody says. “I don’t know of any advantages, aerodynamically.”

“It’s mainly for fun,” Stull says. He points out that it has the same aeronautics no matter how the plane is oriented on its longitudinal axis. That leads him to ruminate about his next possible project. “I’ve got some wild ideas,” Stull says. “Since the ring tail worked, why not ring wings? You could fly the plane on edge, sideways!”

Stull laughs, slapping his knee. His outlandish ideas have a history of actually taking flight. In fact, he says, he’s already begun pencilling sketches. **PM**



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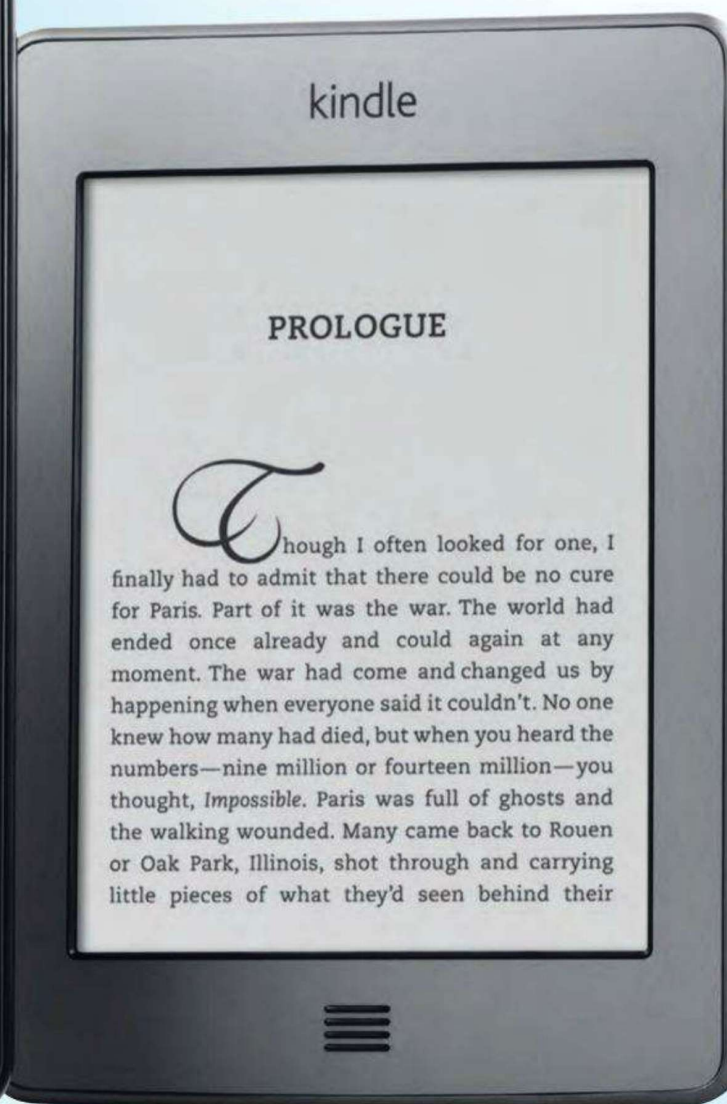
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E-BOOK READERS:

THOUSANDS OF SOUTH AFRICANS HAVE FALLEN UNDER THE SPELL OF AMAZON'S KINDLE E-BOOK READER, A BEGUILING DEVICE THAT DOES ITS JOB WITH MINIMAL FUSS AND IMPRESSIVE EFFICIENCY. NOW SAY HELLO TO THE LONG-AWAITED *KINDLE FIRE TABLET* PLUS A TRIO OF SMALLER, LIGHTER E-BOOK READERS – AN

IMPROVED ENTRY-LEVEL *KINDLE*, THE *KINDLE TOUCH* AND THE *KINDLE TOUCH 3G*.



MOVING THE GOALPOSTS

We were about to go to press with a sneak preview of the new Kindle tablet when Amazon took the wind out of our sails by publishing details not only of their 7-inch colour touchscreen device, but also three new monochrome e-book readers at affordable prices – two of them featuring touchscreens.

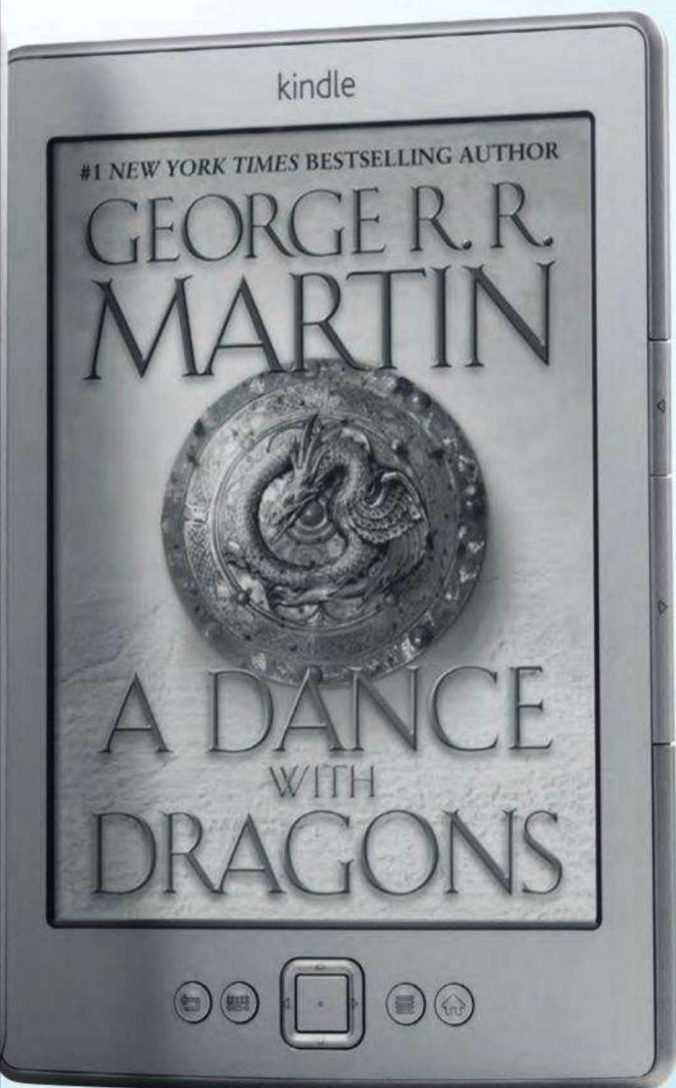
The upgraded entry-level Kindle (it costs R622 in the US) features a design that's 30 per cent lighter and 18 per cent smaller than its predecessor, and turns pages 10 per cent faster. It comes with the same electronic ink display. Joining it is the Kindle Touch, with a touchscreen that makes it easy to turn pages, search, shop, and take notes, and the range-topping Kindle Touch 3G. Kindle's free 3G connection means you never have to hunt for or pay for a Wi-Fi hot spot: you can download and read

books anytime, anywhere, in over 100 countries. Amazon pays for the 3G connection, so there's no monthly fee or annual contract.

Not surprisingly, though, it's the Kindle Fire that's attracting the most attention. Slim, stylish and thoroughly desirable, it features a dual-core processor for fast, powerful performance, an accelerated browser, free storage in the Cloud, the celebrated Whispersync technology, and a brilliant LCD colour touchscreen – all for the equivalent of R1 560. It's apparently available for pre-order only for US customers, but as we've said before, there are ways...

What really excites us about this device is its Web browser, dubbed "Amazon Silk", which introduces a radical new paradigm – split browser architecture that accelerates the power of the mobile device hardware by exploiting the computing speed and power of Amazon's Web Services Cloud. This *really* moves the goalposts.

Here's how it works: the Silk browser software resides both on the Kindle Fire and on the massive server fleet that com-



JUST THE FACTS

Display	7-inch multi-touch display with IPS (in-plane switching) technology and anti-reflective treatment, 1 024 x 600 pixel resolution at 169 ppi, 16 million colours
Size	190 mm x 120 mm x 11,4 mm
Weight	413 grams
System requirements	None, because it's wireless and doesn't require a computer
On-device storage	8 GB internal. That's enough for 80 apps, plus either 10 movies or 800 songs, or 6 000 books
Cloud storage	Free Cloud storage for all Amazon content
Battery life	Up to 8 hours of continuous reading or 7,5 hours of video playback, with wireless off. Battery life will vary based on wireless usage, such as Web browsing and downloading content
Charge time	Fully charges in approximately 4 hours. Also supports charging from your computer via USB
Wi-Fi connectivity	Supports public and private Wi-Fi networks or hotspots that use the 802.11b, 802.11g, 802.11n, or 802.11X standard with support for WEP, WPA and WPA2 security using password authentication; does not support connecting to ad-hoc (or peer-to-peer) Wi-Fi networks
USB port	USB 2.0 (micro-B connector)
Audio	3,5 mm stereo audio jack, top-mounted stereo speakers
Content formats supported	Kindle (AZW), TXT, PDF, unprotected MOBI, PRC natively, Audible (Audible Enhanced (AA, AAX)), DOC, DOCX, JPEG, GIF, PNG, BMP, non-DRM AAC, MP3, MIDI, OGG, WAV, MP4, VP8
Documentation	Quick Start Guide (included in box); Kindle User's Guide (pre-installed on device)

prises the Amazon Elastic Compute Cloud (Amazon EC2). With each page request, Silk dynamically determines a division of labour between the mobile hardware and Amazon EC2 (that is, it decides which browser sub-components run where), taking into consideration such factors as network conditions, page complexity and cached content. The result is a faster and more

satisfying browsing experience.

The Kindle Fire uses IPS (in-plane switching) technology – similar to that used on the iPad – for an extra-wide viewing angle. According to Amazon, the display has been chemically strengthened to achieve 20 times the stiffness and 30 times the hardness of plastic, making it extremely durable and bump-resistant.

Converting your Nook Color to Android

A couple of months ago, we showcased two market-leading ebook readers, Amazon's Kindle and Barnes & Noble's Nook Color – both impressive devices, and each offering a variety of attractive functions.

In the weeks that followed, we read up on a variety of hacks – some of them horrifyingly complicated – designed to convert the touchscreen-equipped Nook into a full-fledged Android tablet. Now, we'd like to introduce a simpler solution in the form of N2A (Nook To Android), a pre-programmed SD card that not only does the job for you, but does so without voiding the device's warranty. The bad news is that the supplier does not ship the card outside the US; the good news is that lots of us have friends in that country (go ahead and exploit them).

The N2A uses a modified version of Google Android called CM7, created by a group of developers – known as Cyanogenmod – who are dedicated to providing the highest-quality Android mods for the Android cellphone and tablet community. N2A are also keen to acknowledge XDA Developers, a large group of Android developers who create new features and bug fixes for CM7 and other projects. Both groups offer their software and updates for no charge under the Android Open Source Project and the GNU Public Licence, which allow N2A to legally use, distribute and support their software and updates.

When you buy the N2A card, you get a quality Sandisk MicroSD card and all the services to get Android and the added features. N2A stress that you are *not* purchasing the software, as this is provided free of charge under the licences mentioned above.

Your N2A microSD card, created specifically for the Barnes & Noble Nook Color, comes pre-loaded with Android 2.3.4 Gingerbread and the Android Market. It does not alter the device's internal memory and will not void your warranty.

How does it work? Piece of cake. Turn off your Nook Color, place the N2A microSD card into the slot behind the grey door, then turn it back on – it's that easy. Everything runs straight from the microSD card. If you take the card out, your device will return to normal, with no trace left behind.

Your newly activated Android Tablet connects to any Wi-Fi 802.11 b/g/n. Once connected, you can open any of the pre-installed apps (such as Gmail, Facebook, Angry Birds, Pandora, Nook or Kindle).

***'It's like owning
a R4 000-plus
Android tablet
for half the price'***



Alternatively, check the weather, news, or your Google calendar. You can also download thousands of free and paid apps from the Android Market. It's like owning a R4 000-plus Android tablet for half the price.

Why not Android 3.0 Honeycomb? N2A say they experimented with Honeycomb early on and found multiple reasons not to use it as the platform for their cards. Honeycomb was created for the Motorola Xoom, and Google has not yet released the source code. When Google finally does so, say N2A, they will gladly step forward. Until then, Gingerbread is the flavour of choice. Who knows, they might just skip Honeycomb and aim right for Ice Cream Sandwich.

• Visit www.n2acards.com



You won't need a can opener for this hack. Converting the Nook Color is painless, non-invasive (well, almost) and perfectly safe.

Introducing the 18 Volt Lithium Ion Family - from Bosch. One battery fits all.

powered by
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technology



Lithium Ion Cordless Multi-Sander PSM 18Li, Lithium Ion Cordless Jigsaw PST 18Li and the PSR 18Li-2 18 Volt drill driver with electronic slide torque control.

Powerful, compact, lightweight and convenient with 30 percent more power and 15 percent more running time. These tools are always ready for use because the Lithium Ion battery does not suffer from self-discharge. Moreover, the battery does not have any memory effect, so it can be recharged at any time without the user having to accept deterioration in battery performance. The LED displays constantly inform the user about the charging state of the battery. Each of the cordless tools comes complete with the 1-hour charger, which charges their batteries very quickly. The PSM 18Li Multi-sander, PST 18Li Jigsaw and the Cordless Drill/Driver PSR 18 Li-2 are available at retail outlets.

For more information visit www.bosch-pt.com/za/en or call 011 651 9802. **You'll be amazed.**



BOSCH

Invented for life



RIDE-ON WONDER →

Budding adrenaline junkies looking for their first set of wheels are sure to enjoy Razor's latest miniature wonder – the Pocket Rocket. This awesome little electric-powered replica of a grand prix superbike boasts a slick, aerodynamic design and high-torque motor that delivers speeds of up to 24 km/h. Capable of carrying riders weighing as much as 77 kg, it has a battery that provides a maximum of 40 minutes of continuous use. Plus, its large 25 cm pneumatic tyres beat the bends comfortably. Additional features include twist-grip acceleration and a hand-operated brake – just like the real thing. Price: about R2 500. Contact distributors Tevo on 0861 778 888 or visit www.razor.za.com



← TABLET OR NETBOOK: YOU CHOOSE

Tablets are great, but they don't have a keyboard. Netbooks have a keyboard, but they're bulky by comparison and don't have the same cool functionality of an iPad. That said, Sena's Keyboard Folio iPad Case provides you with the convenience of both worlds. Apart from protecting your iPad in a snazzy leather outer shell, it features a built-in (removable) silicon Bluetooth keyboard for those who find typing on a virtual keyboard a pain. Aside from the standard QWERTY layout, you get handy play/pause, forward/rewind, mute and volume keys. Heck, there's even a command key with Apple's little command key logo. It incorporates a recessed, collapsible back stand that mimics the set-up of a traditional laptop. Price: about R1 700. Visit www.mystore.co.za



NIFTY LITTLE LOGGER

If you haven't started a log-book yet to keep the tax man off your back, then you'd better get cracking. The Little LogBook, a GPS device no larger than a flash drive, uses a minimum of four satellites to log your kilometres automatically as you drive, and then translates the stored information into a SARS-compliant report.

Once connected to your vehicle's cigarette lighter socket and at least four satellites have been found, it records GPS co-ordinates every three seconds. You can then connect it to your

PC via a USB port and view your trips on Google Maps, with the ability to name your office and regular clients. The supplied software allows you to generate two types of reports: the Summary report provides a breakdown of business vs private kilometres over a tax year period broken up in months, and the Detailed report breaks your distance up into individual trips. Price: about R900. Visit www.littlelogbook.co.za



ALWAYS STAY IN TOUCH

Outdoor enthusiasts who regularly head off over the horizon are sure to benefit from Inmarsat's affordable satellite phone, the IsatPhone Pro. This compact, robust Bluetooth-enabled handset which facilitates both voice and text communication, is designed to work in just about any conditions – be they rain storms, dust storms, searing heat, sub-zero cold, tropical humidity or freezing fog. Operating globally over the Americas, EMEA and Asia-Pacific using Inmarsat's geostationary satellites, it offers up to eight hours of talk time and up to 100 hours on standby.

A one-touch emergency button transmits your exact GPS position in latitude/longitude co-ordinates when you find yourself in a sticky

situation. It also comes with a prepaid SIM card, and loaded airtime remains valid for 24 months. Price: about R5 000. Contact Radio Holland on 021-508 4700 or visit www.radiohollandgroup.com

SMART PERFORMER

Editor's choice

If the whole BlackBerry phenomenon has passed you by, then you'd better get with the programme. RIM's latest handset, the BlackBerry Bold 9900, is the company's first to incorporate a high-performance keyboard and integrated touch display. It's also the first to include built-in support for NFC (near field communications), a new technology that's enabling many new and exciting capabilities, including the ability to pair with NFC-enabled accessories or read SmartPoster tags with a simple tap of the phone.

Its updated operating system introduces the company's next-generation browser, which boasts a significantly faster, more fluid Web browsing experience. Additional enhancements include optimised zooming and panning for smoother Web navigation, as well as optimised HTML5 performance for incredible gaming and video experiences. You also get HD video recording capabilities, and advanced sensors that enable new augmented reality applications such as Wikitude. Price: about R7 600 (or check out your contract options). Contact Vodacom on 0861 123 123 or visit www.vodacom.co.za





LITTLE LENS CHANGER

If you're not familiar with specialist jargon but would like to shoot like the pros, then Sony's latest interchangeable-lens 16-megapixel DSLR, the NEX-C3, could be for you. That's because its intuitive new Photo Creativity interface replaces such mildly technical terms as "aperture", "exposure value" and "white balance" with friendlier terms such as "background defocus", "brightness" and "colour". There's no need to dig into confusing menu options or guess their effect on your composition, either; simply turn the camera's rear-mounted control wheel and you'll see the effect of your settings previewed on-screen.

Advanced multi-frame imaging technologies broaden the possibilities even further. Auto HDR "stacks" a high-speed burst of three exposures to capture extreme shadow and highlight details within a single frame. Similarly, Handheld Twilight and Anti-Motion Blur modes automatically combine six exposures to capture smooth, low-noise images, thus avoiding hand and subject blur when shooting in available light. Expect to pay about R6 500 for an 18-55 mm single-lens kit, and about R7 500 for the twin-lens kit with an 18-55 mm and a 16 mm f2.8 lens. Contact Sony on 011-690 3555 or visit www.sony.co.za



COPY THAT

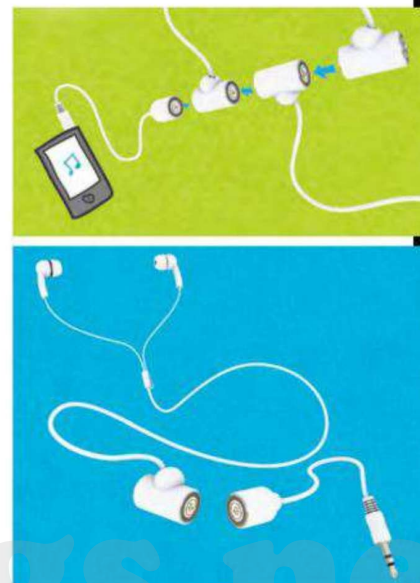
Just because you're in the bush you needn't cut yourself off from all forms of communication. Midland's GTX1000VP4 Pro Series two-way radio kit has an impressive maximum output power of 5 watts – giving the two waterproof handsets a range of up to 58 km.

Apart from 50 channels and automatic checks for activity on any channel, they also offer 284 privacy codes to help block out other conversations. Thanks to eVOX technology, they transmit signals automatically when a user's voice is detected. And there are nine VOX sensitivity levels. For your convenience, you can attach your favourite microphone or headphone. Plus, the silent page and call notification option makes them perfect for after-bedtime hours. Price: about R1 200. Visit www.gadgetmall.co.za

CLICK AND SHARE

Donning a headset makes perfect sense if you want to enjoy your individualised playlists without disturbing others, but when you want to discreetly share your good vibes with a few like-minded buddies, this strategy can be a tad problematic. Fortunately, SkunkJuice earbuds solve all that.

These innovative headsets use magnetism to seamlessly connect up to four headsets to one music player in an instant. The double-sided magnetic connections in their cables ensure a strong hold without compromising audio quality along the entire chain, regardless of how many earbuds are connected. The 1,32-metre cable terminates in a 3,5 mm gold-plated plug. Price: about R300. Contact TID on 010 5000 111 or visit www.skunkjuiceearbuds.co.za



Complete freedom

MTN now offers you unlimited Internet at massively reduced prices. What's not to like!

These days, the flow of information keeps generating more and more worthwhile content, and whether you're blogging, working around the clock, tweeting or downloading music, life without the Internet has become pretty much unthinkable!

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MTN Internet bundles	Monthly subscription
MTN Uncapped Lite	R289
MTN Uncapped Pro	R879

* From 1 February 2012 a fair-use limit will apply. Once the 3GB (Uncapped Lite) and/or 10GB (Uncapped Pro) fair-use limit has been reached, the maximum connection speed will be limited up to 256 and 354 Kbps respectively for the user for the remainder of the month. Both packages are available on 24-month contracts.

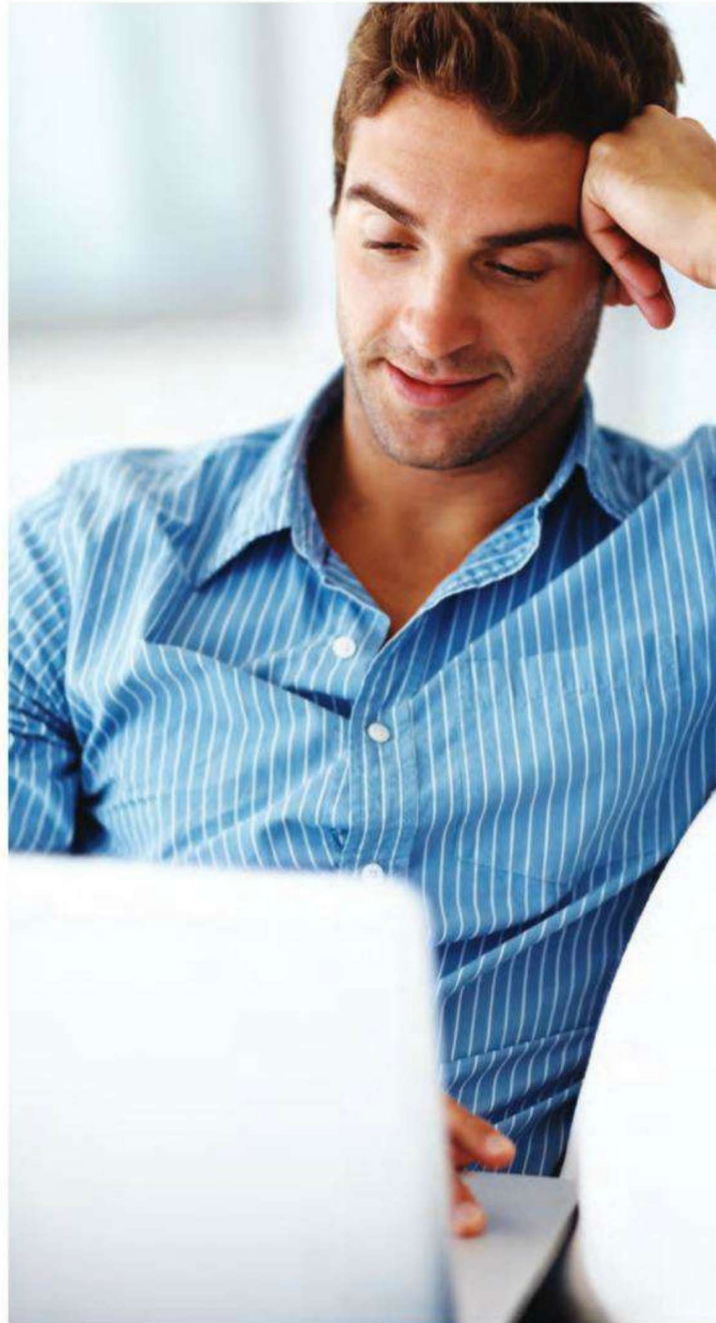
For home

Both MTN Uncapped Lite and Pro packages come with the MTN Sh@relink WiFi Internet router which means multiple devices can be connected to the Internet at the same time. Perfect if you're running your own business, and a great saving for the family at home. This router is included in the monthly subscription fee.

On the move

Getting Internet on the go is easy with the MTN's F@stLink E376, also available on MTN Uncapped Lite for R289 per month.

All MTN Internet users have access to the HSPA+ Network (if they have a capable device or if they're in an area that has coverage) at no additional cost.



MTN Sh@relink B660



MTN F@stlink E376

**For more information, visit www.mtn.co.za
or visit your nearest MTN store**



everywhere you go



↑ BOOST YOUR MEMORY

External hard drives are the logical way to supplement your laptop's memory. It must be said, though, when you're constantly on the road they only add to the clutter you are required to cart around. Western Digital's new Scorpio Blue 9,5 mm 1 TB hard drive, specifically designed for mainstream laptops, solves all that.

Apart from giving your laptop a serious memory boost, it boasts advanced power management features and algorithms to optimise the way it seeks for data, thus significantly improving power consumption. The recording disc heads are parked off the disc surface during spin-up, spin-down and when the drive is off – that means improved long-term reliability thanks to less head wear. Shock tolerance has been increased to 400 gs, protecting the drive mechanics and platter surfaces. Price: about R1 000. Contact distributor Drive Control Corporation on 011-201 8927 or visit www.drivecon.net

→ IMMERSE YOURSELF

When fighting for your life on virtual battlefields, distracting background noise is the last thing you need. Asus' ROG Vulcan

ANC Pro Gaming Headset features active noise cancelling technology to prevent just that. Its 85 per cent active noise cancellation filters out sounds such as low-frequency computer fans, as well as 30 dB passive noise cancellation to reduce a wide range of ambient sounds, including background voices.

Enlarged 40 mm headphone drivers deliver a wide soundstage, with deep bass and brilliant mids and highs. Its stylish blade-shaped detachable boom microphone has built-in noise filtering technology so teammates can hear clear conversations during games instead of ambient noise. Soft memory foam encased in breathable leather ensures a comfy fit during

extended play sessions. It also features a foldable design and comes with a durable travel case. Price: about R1 000. Contact Asus on 011-783 5450 or visit www.asus.com



FREEDOM TO FEED →

New additions to the family are always a blessing, but let's face it: having a newborn can cramp your style. Yoomi's self-warming baby bottle allows you to take care of your little one's needs and still get a life. At its heart is a clever warmer that contains a non-toxic, concentrated salt solution gel. Just to be extra safe, a food grade colourant has been added so that, in the unlikely event of leaks, they will become immediately visible.

To charge the warmer, you simply boil it in water for 25 minutes or run it through an electric steam steriliser for the same length of time. It retains its charge for weeks if necessary. Then, at the press of a button, it heats the milk up to 32-34 degrees in about a minute. The bottle can be used without the warmer and features six built-in anti-colic vents. Price: about R280. Contact Otto Baby on 082 853 8386 or visit www.yoomi.co.za



GOING SOLO →

Portable speakers that connect to MP3 players and the like are nothing new. But a combined portable music player and speaker... now that's something completely different. The shoX solo connects to cell-phones, iPods and MP3 players via its built-in 3,5 mm audio jack cable, but it can do much more. An SD card slot enables it to work as a standalone player and, thanks to its handy USB adaptor, a portable hard drive. A five-way control panel allows you to skip tracks, adjust volume, play and pause. And Linx technology means that any number of shoX solos can be linked together to create jaw-dropping party sound. Price: about R400. Contact distributors Tevo on 0861 778 888 or visit www.tevo.co.za



WHY

should wine be left to mature? Surely wine should be ready to drink whenever you're ready to drink?



Tall Horse

A different take on wine.

Not for Sale to Persons Under the Age of 18.



ÜBER-COOL ENTERTAINER

Audiophiles wanting great portable sound really need to check out Sony's best-ever Walkman, the all new NWZ-A860. Featuring Sony's proprietary new-generation S-Master MX digital amplifier technology to reduce noise levels and distortion, it promises to make your favourite tunes sound better than ever.

A generously sized 7 cm LED-backlit WQVGA touch-screen facilitates fingertip browsing of content, including viewing images, videos and album art. Bluetooth connectivity allows you to stream your good vibes to headphones, your hi-fi or in-car system as well as to share files and photos with other Bluetooth devices. Its 8 GB of memory can store around 1 750 songs. You get a continuous playback time of about 23 hours (Bluetooth off) or 8 hours (Bluetooth on). Other features include FM radio, karaoke mode and a Li-Ion battery that's charged via a USB. Price: about R2 000. Contact Sony on 011-690 3555 or visit www.sony.co.za



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IRONMAN, HERE WE COME

It goes without saying that elite athletes need a dedicated training device that's as tough as they are. Well, Timex's Ironman Global Trainer, with its Bodylink system, is just that. This GPS-enabled watch features intuitive performance and multi-sport modes for both training and events. It precisely calculates speed, pace and distance while measuring location and altitude with ascent/descent distances and rates. Requiring no calibration, it records up to 100 location waypoints, allowing users to track back and create routes. It can recall up to 50 custom routes for pace tracking.

The 20-workout memory offers dated summaries of up to 1 000 laps, and there are chronograph and interval timer functions. A performance pacer helps users meet their finish-time goals. It also includes a hands-free option that automatically starts and stops data capture, and a multisport event mode to track and record activity specific data, including transitions, in a user-defined sequence.

Price: about R3 500.

Contact distributor

Just Time on

011-405 3300

or visit www.justtime.co.za

PM



SA's new Superphone!



HTC Sensation

A Dual Core Processor for a new multimedia high

Connect wirelessly with DLNA streaming to any enabled device.

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Experience HD with a QHD screen for crystal-clear viewing.

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TABLET WARS, ROUND 3:

Down to the wire

Although other tablets have a higher profile, and new adversaries are entering the battlefield at a cracking pace, we suspect it's only a matter of time before these two contenders make their presence felt in a big way.

ASUS EEE PAD TRANSFORMER

Okay, now that we've played with it (any more *Angry Birds* and we'll need shock therapy), provoked it (opening and closing apps with reckless abandon) and even slept with it (hey, some people get very close to their tablets), we can state with utter conviction that the Asus Eee Pad Transformer 10.1 is a very fine product. And yes, a legitimate iPad 2 rival.



What's to like? Rather a lot, actually. First up is the Nvidia Tegra 2 dual-core processor, which allows you to multi-task like a maniac, browse the Web at breakneck speed (that is, when the rest of the country is asleep) and view your favourite videos in all their crisp, razor-sharp glory at angles of up to 178 degrees, so it's by no means a selfish device.

In fact, the specs are quite formidable. Its HDMI 1.3a port allows the Transformer to connect to a HDTV and 5.1 surround sound system, delivering an impressive multimedia experience at a useful HD resolution of 1 280 x 800. We're not quite sure why the designers surrounded the 10,1-inch screen with a wide black bezel plus a rim of metal; perhaps they needed the extra room for electronic components.

The 5 MP rear- and 1,2 MP front-facing cameras can shoot and record HD video, and the tablet distinguishes itself from rival products with an optional docking station. This provides access to a full QWERTY keyboard, along with unique Android Function keys that turn the tablet into a full-fledged notebook while extending battery life to 16 hours. Build quality is excellent throughout, although the magnificent iPad 2 takes the design crown.

A 3,5 mm audio jack, two USB ports and a built-in SD Card reader allow easy file sharing and storage expandability (taking advantage of the microSD slot in the tablet and the SD card slot in the dock), making the Transformer a versatile media hub. Google's Android Honeycomb operating system works like a dream, and we had loads of fun exploring the fast-growing

Android Market. For the record, if you haven't "zombified" your friends in the Zombie Booth, you haven't really lived.

COST: R4 299 (16 GB) and R4 999 (32 GB), plus R1 499 for the optional dock.

TOSHIBA AT100

Comparing Toshiba's robust tablet – actually, plump might be a better word – with the ASUS Eee Pad Transformer makes perfect sense. They share a 10,1-inch touch-screen, offer similar ports and features, and run almost identical software. However, they are by no means thinly disguised clones.

Let's kick off with the important stuff. You get the 1 GHz Nvidia Tegra 2 dual-core processor plus Android 3.1 Honeycomb, which is good. The multi-touch display has a resolution of 1 280 x 800 pixels, providing ample room for viewing Web sites in landscape or portrait mode, and allowing a cinematic experience for video viewing and gaming. Front- and back-mounted cameras make chatting easy, and photography er... a snap. Providing up to eight hours of mixed browsing and video playback, the removable and easy-to-exchange batteries mean the Toshiba AT100 is always ready to go. Oh, and it recharges in an amazingly short time.

A very cool feature is Adaptive Display, which works by constantly adjusting parameters such as brightness and contrast according to the ambient lighting conditions, making sure that you get the best possible image display. We've had mixed reports on this: whereas some users are impressed, others say they need to turn the brightness way up to achieve acceptable views.

Toshiba is also proud of its Resolution technology, which tweaks the quality of standard-definition videos to exploit the full potential of the AT100's high-def display, independent of the quality of the source material. Good sound quality is achieved with various audio enhancements that adapt sound output to the surrounding conditions.

Toshiba's new tablet, weighing in at a somewhat hefty 765 grams, features a built-in gyroscope, an accelerometer, integrated GPS, a 2 MP front-facing camera and 5 MP rear-facing camera. It also offers multiple connectivity options and ports – specifically, a full-size HDMI port, a full-size USB 2.0 port (for connecting external hard drives and cameras), a mini-USB port and an SD Card slot... all of which makes for easy integration into your digital life.

Naturally, it comes with wireless connectivity (Wireless LAN 802.11b/g/n) and Bluetooth (version 2.1). All in all, it's a neat, stylish – personally, we like a little beef in our tablets – and thoroughly appealing device, and it comes with a recommended retail price of R5 499.

PM



Rethinking THE HOME of the FUTURE

22 BIG IDEAS FROM THE 2011 SOLAR DECATHLON

> BY HARRY SAWYERS

ILLUSTRATIONS BY ANDREA MANZATI

PHOTOGRAPH BY MISHA GRAVENOR



The appeal of the Solar Decathlon? “These are homes you can actually walk through, with systems you can see,” Team California project manager Elisabeth Neigert says, standing in the partially built CHIP house on the Southern California Institute of Architecture (SCI-Arc) campus. “We come together from all over the world to tackle the problems of tomorrow’s housing – to show what’s possible today.”

The Solar Decathlon, a biennial contest in which 20 teams of US university students build houses that produce as much energy as they consume, was in the ironic position of homelessness in January 2011: the competition had lost its spot on the National Mall in Washington, DC.

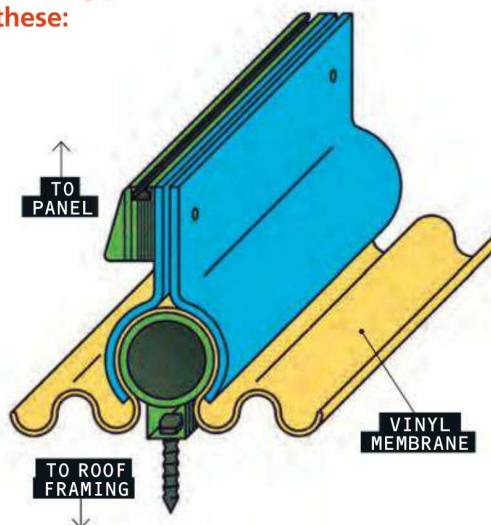
The news broke during the International Builders' Show, where teams had met to show off models of their projects. The students were bummed. So they organised themselves and lobbied the government. Team California's Elisabeth Neigert (left) pleaded their case in *The Huffington Post*.

In the end, the students won. The competition, organised by the US Department of Energy, was due to go ahead in the original venue, with the public able to tour the homes and see students testing brilliant ideas – such as these 22 – in real-world conditions, one watt at a time.

1-5

TEAM CALIFORNIA → CHIP

CalTech and SCI-Arc's CHIP (Compact House, Infinite Possibilities) combines engineering and architecture to challenge conventional building practices with concepts such as these:



SOLAR PANEL CLAMPS Rather than penetrating a rooftop with a racking system (which can void roofing warranties and lead to leaks), students combined panel-mounting IronRidge rails with a home-made clamp-and-pipe system that can pinch the panels into place while the vinyl roof membrane remains unbroken.

POWER FOR EV PARKING Planning for a vehicle isn't a competition requirement. But Team California figured out how to use CHIP's cantilevered upper floor to create an electric-vehicle carport under the bedroom. Beefy wiring connects an exterior outlet to a 20-amp breaker, using the 8,0-kW photovoltaic (PV) system to charge an EV.

AUTOMATIC A/C When asked to name the single best piece of CHIP's heating and ventilation equipment, CalTech student Fei Yang rattled off a model number: Mitsubishi MXZ-2B20NA-1. This air conditioner takes infrared measurements of the house; then automated

louvers blow cool air to hot areas.

CONTROLS VIA KINECT A CalTech modification makes Microsoft's Kinect system for the Xbox 360 function like a next-gen Clapper. The system, described by designer Cole Hershkovitz as a "gesture- and location-based home-control interface", senses specific body motions to turn on lights, fire up the stereo or switch on the TV.

BILLBOARD CLADDING The team used vinyl-coated polyester, which could be recycled from billboards, as impervious external wall cladding. The white cladding also wraps the roof.

6-8

TEAM NEW JERSEY → ENJOY HOUSE



THERMAL MASS Team New Jersey (Rutgers and the New Jersey Institute of Technology) squeezed 150 mm of expanded polystyrene insulation inside its home's 30-cm-thick precast concrete walls, floor and roof. In winter, the slabs absorb daytime solar heat and release it throughout the night.

U. OF MARYLAND → WATERSHED



SOLAR PERGOLA As a backup to a 9,2 kW photovoltaic array on the south slope of its split-butterfly roof, the WaterShed has a solar pergola above its kitchen door. Six 220-watt panels shade a small deck. Micro-inverters convert DC current to AC current at each panel, eliminating excess wiring.

TEAM NEW YORK → SOLAR ROOF POD



MODULAR BLOCKS The City College of New York's Solar Roof Pod, designed to perch atop a four- to six-storey structure, includes 2,4 x 1,5 m building blocks that can be used as walls, windows, photovoltaic mounts or glass prisms. Owners can customise the 165 mm-thick blocks' configuration.



Students at Appalachian State found a way to boost solar thermal tubes' collection capacity by using a simple homemade rig and a very complex algorithm.

10-13

4 IDEAS TO TRY AT HOME

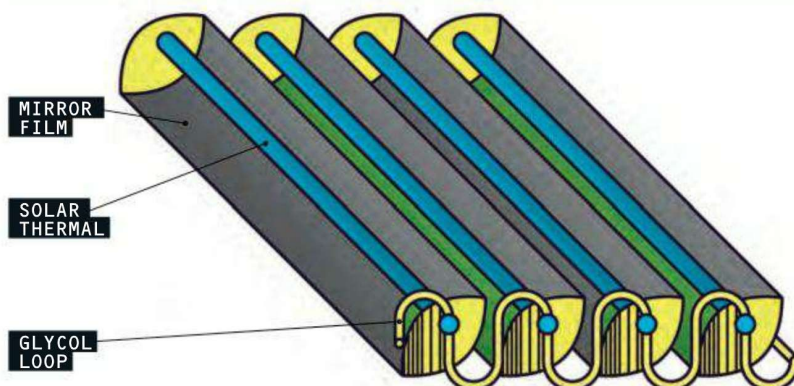
TRACK ENERGY USE > The eMonitor system by Intellergy, featured in Middlebury College's home, displays power consumption as an average or in real time. A top-five list reveals which appliances consume the most juice – info that can curb consumption.

RECOVER HEAT > The Ohio State University's enCORE house uses an energy-recovery ventilator as part of its heating and ventilation system. The device, which can be retrofitted onto ductwork, passes heat from outgoing indoor air into fresh air as it enters the home. This reduces the load on heating and cooling by capturing energy that would otherwise escape as exhaust.

GO NATIVE > Taking its cue from the Chesapeake Bay lowlands, the University of Maryland built a constructed wetland to manage rainwater and filter greywater. Residents can navigate the native landscaping on rot-resistant cooked-ash decking, which is fired in a kiln and similar to pressure-treated timber. >>>>>>>>>>

AMP UP AN AWNING > Semi-transparent Sanyo solar panels cast diffuse light on Appalachian State's porch. The partial shade is pleasing and powerful, plus the 42 panels collect UV on both faces to yield about 195 watts apiece.

APPALACHIAN STATE UNIVERSITY → THE SOLAR HOMESTEAD



CUSTOM REFLECTORS Mirror-lined troughs beneath an array of solar thermal tubes make each one more efficient at heating a glycol loop, which transfers energy to warm the Homestead's water. To mould the trough, students pressed flexible mirror film face-down on a length of 325 mm-diameter PVC pipe, clamped it in place with a pair 50 x 100 posts on hinges, then spread fibre and epoxy on the rear to create a firm glass fibre backing. It's a simple process, but figuring

out the exact angle of the trough's arc and its optimal distance from the tube took engineering physics graduate student Neil Rifkin two full semesters of hardcore number crunching. Parabola? Circle? The sun's position over Washington, DC, in September? "Once I figured that out, building the reflectors was the easy part," he says. The resulting 1,8 x 5-metre thermal array is part of a solar skylight above the home's otherwise windowless mechanical core.



Senior electrical engineering major David Daily runs wire from the service panel to outlets and fixtures throughout the University of Maryland's WaterShed.

TOUGH ON SWEAT. NOT ON SKIN.



48HR
PROTECTION

1/4
MOISTURISER

NEW

Dove Men+Care™ Anti-Perspirants combine powerful anti-perspirant ingredients with advanced $\frac{1}{4}$ moisturiser technology in distinct fragrances, to protect against sweat and odour and help guard against skin irritation. Available in Aerosol, Roll-on and Stick formats.

POWERFUL PROTECTION

Counterweights help raise and lower hurricane-resistant, 204 kg shutters as quickly as closing a garage door.



14

FLORIDA INTERNATIONAL UNIVERSITY → PERFORM[D]ANCE HOUSE

"Hurricane shutters are quite ugly," FIU project manager Andy Madonna says. His team's solution: 10 cantilevered, counterbalanced shutters that shade the house and porch. The shutters batten down to weather a storm, or just add privacy, in a quarter of an hour – one-eighth of the time it takes to set up the hurricane shutters sold today. "We're trying to bring a new product to the market," Madonna says.

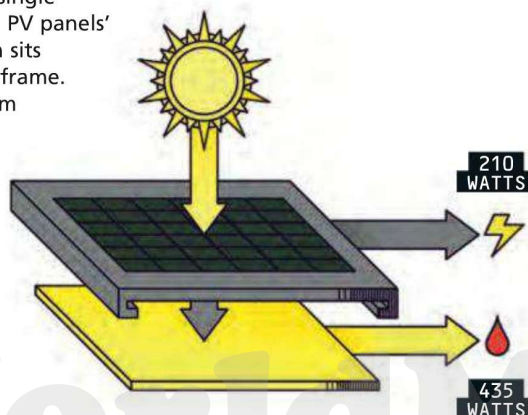
TEAM MASSACHUSETTS → 4D HOME

15

HYBRID PANELS

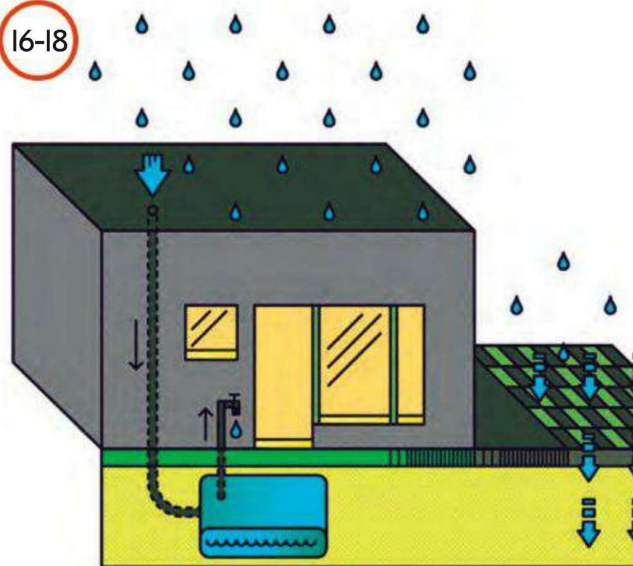
The Massachusetts College of Art and Design and the University of Massachusetts, Lowell, combined electricity-producing photovoltaic panels and water-heating solar

thermal collectors in a single hybrid module. Normal PV panels' 12 mm silicon sandwich sits in a 32 mm aluminium frame. The 4D Home's SunDrum solar hybrid system fits a 6 mm flat-plate solar thermal collector into the extra space, leveraging it to heat domestic water while making the PV panel cooler and more efficient.



16-18

PARSONS • MILANO • STEVENS → EMPOWERHOUSE



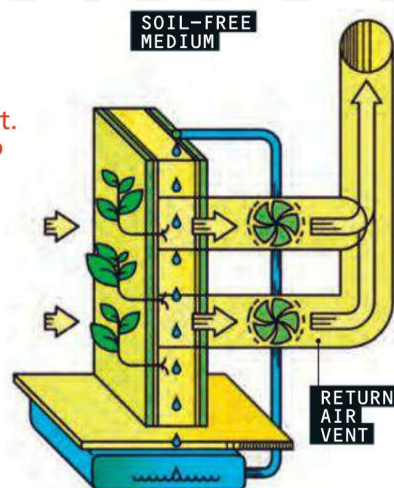
RAIN WRANGLER To manage rainwater, the street kerb's permeable pavers filter storm run-off into the soil. Rainwater that hits the roof feeds into a 4 000-litre underground cistern, accessed for garden use via a spigot. Surplus water feeds a sunken rain garden.

19

PURDUE U. → INHOME

Plant roots rid air of formaldehyde, benzene and other volatile organic compounds. Seriously. Nasa proved it. Team Purdue adopted the science to design its vertical biowall.

FLORA FILTER A 1,8 x 5 m vertical wall of plants cleans the INhome's air as it enters a ventilation and heating return vent. Purdue student Kevin Rodgers designed the garden to grow in a soil-free, porous fabric medium fed by fertiliser-rich drip irrigation. "We use common plants such as golden pothos and heart-leaf philodendron. Pass large amounts of air through the roots, and that's when you see benefits," Rodgers says.



MIDDLEBURY → SELF-RELIANCE

20



IMPENETRABLE WINDOWS To prevent energy loss through a window wall, architecture co-lead Joseph Baisch specified German Optiwin windows, which use a triple-pane design to resist heat transfer at a stout R-7 rating. The windows, plus R-42 walls and an R-74 roof, take insulation to the extreme.

UNI. OF TENNESSEE → LIVING LIGHT

21



DUAL FAÇADE Two double-layer windows enclosing a 30 cm air gap cover the home's north and south walls. "We can maximise transparency, light and view without compromising the thermal envelope," project manager Amy Howard says. Automated blinds between the glass panels further reduce heating/ventilation system load.

AFTERLIFE Once the Solar Decathlon ends, many of the contest's houses end up sitting idle. But the team of Parsons The New School for Design, Milano (The Milano School of International Affairs, Management and Urban Policy at The New School) and the Stevens Institute of Technology identified the DC neighbourhood of Deanwood as the ideal permanent venue for its Empower-house. The team plans to show an

80 m² competition version of the house on the National Mall. After the Decathlon, that home will combine with a second building to create a 250 m² family dwelling.



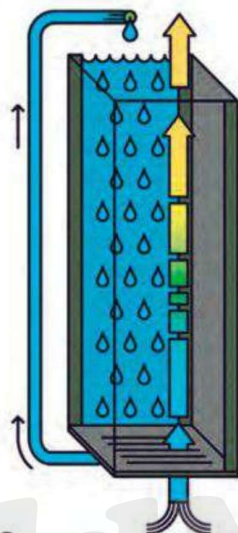
LANDSCAPE DESIGN

The team chose to surround its house with American hornbeam trees because their slight stature won't block the sun from reaching a 5 kW solar panel array. Plants such as hydrangeas and switchgrass filter heavy metals, removing them from the garden's soil.

TEAM FLORIDA → FLEX HOUSE

To manage humid air using one-third the electricity required by an air conditioner, students from Florida State University designed a liquid-desiccant waterfall.

22



DRIZZLING DEHUMIDIFIER "It's basically salt water," Florida State mechanical engineering graduate student Jon Pandolfini says about the calcium chloride blend flowing down a 2,3-metre acrylic sheet. Visible in the house, the sealed chamber doubles as an ventilation system duct. Humid outdoor air enters the duct, then the desiccant collects moisture. Combined with an energy-recovery ventilator, which heats or cools air but doesn't dry it, the system beats the swamp heat without wasting wattage.

PM



VIDEO

> Visit the DOE Solar Decathlon YouTube channel to take virtual tours of the various houses.

LONG WALK TO WHEELDOM

2011 FRANKFURT MOTOR SHOW

The Footsore Four Thousand – no, it's not a footrace: just the collective term for the weary participants hustling from media scrum to media scrum in an effort to stay on top of the almost unimaginable amount of square metreage that is the Frankfurt Motor Show.

Yet, with feet up at the conclusion of a whirlwind visit to the world's biggest car show in September, a straw poll bore out an initial impression: it was petrolhead heaven as always, but strangely lacking in absolute showstoppers.

Still, a good many cars – some of them production models – caught our eye. The following pages feature a few favourites.

FRANKFURT FAVOURITES... FRAN



WHEELS FOR THE YOUNG

OPEL ELECTRIC CAR CONCEPT

Attempting to design wheels that appeal to younger drivers can be a dangerous undertaking. There's little doubt that this racy-looking concept from Opel has every chance of raising more mature citizens' eyebrows – a response that most yooof would regard as a positive thing.

Amazingly, Opel says that this electric car concept, which has a range of 100 km and a top speed of 120 km/h, has production potential. The company reckons it could revolutionise urban transport, especially for younger drivers and

those on a very tight budget. Teenagers could be allowed out in versions limited to 45 km/h.

It's not too impractical, with two seats in a tandem layout. Said to have been inspired by the Opel Ampera, it has been touted as the start of a new class of lightweight, zero-emissions electric vehicles in the UK and Europe.

Energy requirements 10 times lower than those of a modern small car, and energy costs of one euro per 100 km, benefit the environment as well the budget, says Opel.





UP! AZZURRA SAILING TEAM



GT UP!



ECO UP!

VARIATIONS ON A PEOPLE'S CAR

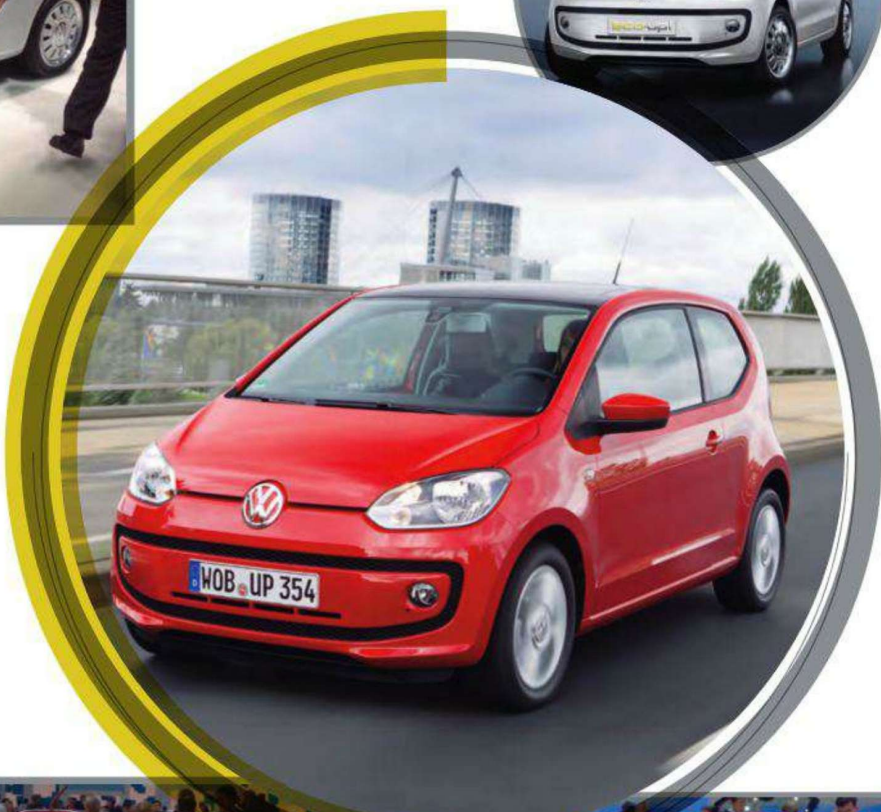
VW UP!

Getting back to its compact-car roots, Volkswagen went all out with its new baby at Frankfurt. In a footprint of just 3,54 metres, the up! seats four at a price, in Germany, of about R100 000.

The up! comes standard with stability control and is the first car in its class to have an optional automatic city emergency braking function.

Drivetrain options include two petrol engines (44 kW and 55 kW), and 50 kW natural gas engine. Fuel consumption of the 44 kW version with BlueMotion Technology (including Stop/Start system) is 4,2 litres/100 km.

There are three equipment versions for different budgets and needs: take up! is the entry-level version, move up! the convenience-oriented model, and high up! is the top version. For Frankfurt, several customised versions were on display, including a GT, buggy, a "Cross up!" echoing other VW models such as the CrossPolo, and a version celebrating the Italian sailing team.



BUGGY UP!



CROSS UP!

WHERE SPORTS CARS ARE GOING

JAGUAR C-X16

Sports cars are compact and agile. They're also two-seaters. Naturally, they're powerful. And in the 21st century, they are most definitely sustainable.

So the Jaguar C-X16 performance goes the hybrid route, with an electric motor providing a "turbo boost" to its main 280 kW 3,0-litre V6. According to Jaguar, this "production concept" indicates the next evolution of Jaguar's design direction.

"The C-X16 is our compelling vision for a 21st century Jaguar sports car," says Adrian Hallmark, Global Brand Director, Jaguar Cars.





BLENDING CRAFTSMANSHIP WITH HIGH-TECH

VOLVO CONCEPT YOU

Inside a sleek coupé-like shape, the Volvo You concept's luxurious high-tech interior keeps the driver in command via intuitive smart pad technology.

The You picks up where the Universe, revealed at Auto Shanghai earlier this year, left off. Volvo says the concept shows off the craftsmanship and intuitive technology we can expect in future Volvos.

"The new roofline stretches all the way back to the tail lamps, creating that dynamic fastback look that is very much in vogue among European car buyers at the moment," says Peter Horbury, Volvo's vice-president (design).

It explores new territories in a search for the ultimate intuitive car that makes the owner's manual a thing of the past. "Smartphones and smartpads have brought mobile infotainment into a new era. Here, we use a number of touch-screens to replace buttons and controls to make the driver totally connected, totally in control. The technology also helps us to create a refreshingly uncluttered interior," Horbury says.

The Concept You control centre

consists of four main areas: a digital Driver Information Monitor (DIM), a head-up display on the windscreen, a touch-screen in the upper part of the centre console and a touch-screen between the two individual rear seats. The wood/leather steering wheel has aluminium and glass paddles with integrated touch-screens.

The touch-screen in the upper part of the centre console remains in sleeping mode until the driver looks at it. A hidden infrared camera registers the eye movements and information is displayed on the screen.

Another sensor registers hand movements and triggers the infotainment system's control mode, depending on whether the screen is approached by the driver or by the front passenger. Certain functions, such as surfing the Web, are accessible only from the passenger side while the car is rolling.

The driver can "flip" data from the central touch-screen to the head-up display – and can exchange data with the rear passengers. A light guide in the free-floating centre console indicates file transfer.

The infotainment system also integrates a high-end sound system from Alpine. It features a unique "FreshAir" subwoofer. This technology, not yet in production, uses the air outside the car to enhance the sound inside it. We can't wait to find out how.

In crafting the interior, Volvo partnered with several other famous brands to create a genuine feeling of luxury with the right Scandinavian touch. The four individual seats, inspired by ultra-comfortable chairs, blend chrome-free leather from Bridge of Wear with Dinamica ecological suede. The back of the front seats and the door panels feature exclusive Italian fabric and designs from Swedish fashion house Oscar Jacobson, and there are large walnut accent panels, aluminium detailing and a wooden floor covered with a hand-tufted carpet from Swedish brand Kasthall.

The design of the wheels, the grille and headlamps details have been inspired by Danish design house Georg Jensen.





OLD FAITHFUL GETS A MAKEOVER

LAND ROVER DC100 SPORT CONCEPT

Defender fans have been frothing at the mouth that anybody could dare to meddle with their favourite 4x4 by far, but there's no question that, with the DC100, Land Rover has kept the Defender DNA. According to Land

Rover, the concepts capture the flexibility, adaptability and configurability that have always been key attributes and continue in today's Defender, but incorporate cutting-edge, sustainable, and hi-tech materials.

"In creating these concepts, we took the functional design cues from the past and re-interpreted them for the 21st century," the company says. The two studies presented – one a short wheelbase wagon and the other an open-top

sports model – represent Land Rover's thoughts on how they will forge "an entirely new generation of Defender models which will prove that design can work in harmony with function".

Er... yes.



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BEST OF BOTH?

PEUGEOT 3008 HYBRID4

Besides being a rather pretty seaside region, Rance on France's west coast is the site for the world's second-biggest tidal power generator. So it was appropriate that Peugeot chose this eco-friendly backdrop for the launch of the world's first full diesel electric hybrid, the 3008 Hybrid4. Coincidentally, the region also has a combination of winding rollercoaster roads, town driving and freeways to give a good indication of how well this set-up performs in the real world.

The 3008 crossover may not be new, but its drivetrain certainly is. Up to now, hybrids have been designed using petrol engines because of diesels' inherent drawbacks of lack of revvability and higher emissions. The Peugeot mates a 120 kW 2.0 litre particulate-filtered HDi, driving the front wheels, with a 27 kW electric motor driving the rear. The really eye-opening figure is the combined peak torque of 400 N.m.

That gives you not only a hybrid powertrain, but also four-wheel drive ability. The layout allows either the diesel to

operate, or the electric, in normal 2wd running, with the option of 4wd where needed. A four-position drivetrain switch allows selection of the desired mode – ZEV (zero emission), sport, 4wd or auto – but Peugeot suggests leaving it on full auto for best management of the hybrid system.

In general driving we clocked between 5 and 6 litres/100 km, but in a town circuit driven with economy in mind we got our average down to an impressive 3,8 litres/100 km. Overall, the system operates seamlessly, and the automatic transmission's gearshifts are particularly slick: the electric motor is actually used to smooth out the shifts. Incidentally, the compact electric component of the drivetrain is located in the rear suspension and takes up about as much space as a spare wheel. The Hybrid4 doesn't, in fact, have a spare wheel: it is supplied with a get-you-home pump system to refill the tyre in the event of a puncture.

For the moment, the Hybrid4 won't be coming to South Africa.



COMPACT ROCKET

FORD FIESTA ST CONCEPT

Hot Escorts and the like are a distant memory of Ford's rich history of performance on a budget. The ST Concept hints at how a future Fiesta ST global performance model might look, according to Ford.

Inspired by the Fiesta race and rally cars currently competing on the world stage, it is also influenced by the all-new Focus ST.

Like Ford's World Rally Championship contender, the Fiesta RS WRC, Fiesta ST Concept uses a 1,6-litre turbo-charged Ford EcoBoost petrol engine to combine economy with power. It features twin-independent variable camshaft timing (Ti-VCT) and its 134 kW and 240 N.m are good enough for 0-100 km/h in less than 7 seconds and a top speed over 220 km/h. With a 6-speed manual transmission, it's rated for CO₂ emissions under 140g/km.

Body detailing includes a rear diffuser, twin exhaust, 17-inch alloy wheels and body kit that mirrors the styling of the Fiesta WRC competition car.

LOOKING AHEAD

FORD EVOS CONCEPT

A new era in personalised transport technology, with a smart adaptive car plugged in to the driver's lifestyle via his "personal cloud", is presaged in the Evos.

Imagine climbing into your car and having it automatically play the same music or news programme that was just streaming at home. And having the interior pre-heated or cooled to just the right temperature, based on a predicted departure time on your calendar. You wouldn't even need to hit the garage door and light-switch remote: that would be done wirelessly, automatically.

Welcome to the car as PA.

Ford's first global design language, and the company's new vision for





FORD EVOS CONCEPT

customer-focused and intuitive technologies, are showcased in this dramatic four-door, four-seat fastback concept with lithium-ion plug-in hybrid powertrain.

Technology is not an end in itself, says Ford's chief technical officer and vice-president of research and innovation, Paul Mascarenas. "(I)t's about the application of that technology to create an experience that enhances the driver's time

behind the wheel."

The idea is to connect seamlessly between the car and the driver's "personal cloud" of information linking a lifestyle that encompasses home, office and car.

We'll see a car that knows the driver and automatically adapts handling, steering and engine controls. It will pull in data on everything from work schedule to local traffic or weather conditions.

FRANKFURT FAVOURITES... FRANKFURT

"We're researching how we can use patterns or preferences set by the driver to make life simpler," said Mascarenas. "The car gets to know you and can act as a personal assistant to handle some of the usual routines of a daily commute.

"From recommending a great driving road from friends on your social networks or resetting your alarm clock to let you sleep in when a morning meeting gets cancelled."

The same concepts are extended to adaptive vehicle technologies for driving.

Instead of drawing on a stored database or map of drivers and road conditions, the new concept foresees tuning handling and performance to the road ahead and the specific individual behind the

wheel. Learning driver habits and capabilities, the technology can overlay map and weather data sourced from the cloud to adjust powertrain, steering, suspension and braking systems for optimum enjoyment, comfort and safety. It can go even further, selecting the optimum combination of the hybrid powertrain's modes for any given journey.

But that's not all: it also looks after the driver. With Ford researchers already having developed technologies focused on driver wellness, such as a heart-rate monitoring seat and allergy-free interiors, a connection to the cloud will supercharge the system's ability to optimise the driving experience. It can even suggest a healthier route...



F70

FOUR-STROKE

distinguished through innovation.

The F70 is a new addition to the Yamaha mid-range 4-stroke stable. Using advanced features and technology to make it extremely light yet very powerful, it is the ideal outboard for a myriad of lightweight fishing boats. Featuring the lightest weight and highest horsepower-per-liter-of-displacement in the 70hp class, the Yamaha F70 takes advantage of the leading edge of technology while maintaining the fuel-efficient, smooth, and quiet operation Yamaha 4-strokes are known for.

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PUMPING UP THE VOLUME

HYUNDAI'S 2011 COMPACTS

Hyundai's new-model tsunami just shows no sign of losing momentum. This year we've been impressed by the i10 hatch-back mini, followed in short order by the imposing Sonata sedan. Surely they couldn't keep this up? Well, if the Elantra and its follow-up, the Accent, are anything to go by, they have: class acts, both.

ACCENT

The Accent is where it all started for Hyundai, as the Pony in the mid-1970s. Now into its seventh generation, the company's mainstay sub-compact sedan continues to move on up the premium-class ladder with a feel considerably more sophisticated than its predecessors. Its organic lines bear Hyundai's "Fluidic Sculpture" family look and coupé-like profile, like the Sonata and Elantra.

It's bigger by 7 cm in the wheelbase than the previous car, which is felt directly in more space – Hyundai says the front leg room of 1 602 mm wouldn't be out of place on a medium car. In fact, the only place that the dimensions have been reduced is in height – down by 13 mm – but there is apparently no sacrifice in headroom. The boot is said to be big enough for a golf bag.

A new-generation 91 kW 1,6 litre Gamma in-line four-cylinder with double overhead camshafts and Constant Variable Valve Timing (CVVT) replaces the Alpha engine of its predecessor. It is mated to a 4-speed automatic or a standard 5-speed manual gearbox. Economy is, on average, 6,0 litres/100 km for the manual version and 6,4 for the auto.

Besides substantial use of high-tensile steel for better crash performance with reduced weight, the Accent features ABS brakes and airbags for both front occupants.

In keeping with its upmarket progress, the Accent comes with a comprehensive package of comfort and convenience features, from iPod connectivity with Bluetooth (certain models) to trip computer and Eco-Drive indicator, heated power rear view mirrors and rear park assist warning.

Price: from R146 900.

**ELANTRA**

These are no longer budget cars. They may not be the most expensive, but they certainly have no need to stand back in the important areas of this compact sedan zone: quality, comfort and refinement. This Elantra takes a huge leap up from its predecessors. Its sleek, lowered look and sculpted lines not only catch the eye, but it's also relaxing when driven slowly, sporty driven fast, and it feels well screwed together.

Even more importantly, its price is competitive.

Everything from power outputs to fuel efficiency, aerodynamics, space, refinement and safety have been upgraded. For instance, safety escort headlamps remain turned on for 30 seconds after the driver leaves the car, there's an auto defogging system, and GLS versions get rear parking assistance sensors. Its six-airbag system includes curtain airbags in the 1,8 GLS derivatives.

Two engines are available. The all-new 110 kW 1,8, which delivers 178 N.m at 4 700 r/min, replaces the 2,0 litre Beta engine used in the previous Elantra. It is smaller, weighs 33,6 kg less and gets an 18 per cent better highway economy.

The improved Gamma 1,6 MPI D-CVVT engine develops 96 kW at 6 300 r/min and 157 N.m at 4 850 r/min. Mechanical improvements include mechanical lash adjustment to reduce friction and valve clatter, and a new design of intake/exhaust manifold that improves engine performance while reducing chronic problems and enhancing durability, Hyundai says.

Competitive edge: smooth shift On the Elantra, both engines are mated to a 6-speed manual transmission. The optional (on the 1,8) 6-speed automatic transmission with SHIFTRONIC manual control was developed and manufactured in-house, and is said to be the world's first to be designed for engine applications in small to mid-sized passenger cars. With three planetary gears, two clutches and three brakes, it's smaller, more compact and lighter than any other six-speed auto transmissions on the market today. Hyundai is one of only three global car manufacturers with its own unique six-speed automatic transmission layout.

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Great South African INVENTIONS

As the countdown starts for the **PM Inventors Conference** on 24 November, we present the second batch of *Great South African Inventions*, most of them drawn from the eponymous book by Mike Bruton.



CAT SCAN

The invention of the CAT (Computed Axial Tomography) Scan was a combined effort by the British electrical engineer, Godfrey Hounsfield, and the South African physicist, Allan MacLeod Cormack, who was based in the United States; they jointly won the Nobel Prize in Medicine in 1979. They worked separately on the development of the CAT Scanner and the only time they ever met was at the Nobel Prize award ceremony.

In 1957, Cormack developed algorithms that used information from X-ray "slices" of a patient's body to create a tomographic, or 3D, image of the whole body. These reconstructions were the first computed tomograms ever made – although his "computer" was a simple desktop calculator.

Cormack had difficulty raising interest in his research – partly because computers of the day were unable to make the neces-

sary calculations quickly enough. Godfrey Hounsfield came to the rescue, developing a method of his own for computed tomography. He constructed the first practical scanner, which was designed to examine the head. When it was first tested in 1972, this machine provided doctors with their first 3D look inside the human body. A whole new field of medical research and diagnostics had been opened up.



HIPPO WATER ROLLER

The Hippo Water Roller, known previously as the Aqua Roller and renamed in 1993 to give it a more "African" flavour, was invented in 1991 by two South Africans, Pettie Petzer and Johan Jonker. It meets a pressing social need. Women in rural areas often carry water for long distances, balancing buckets on their heads. This is not only exhausting and uncomfortable, but can also lead to neck injuries.

The tough plastic drum, which won an SABs Design for Development Award in 1992, rolls along easily with a full load of 90 litres of water and does not need to be lifted and carried. It has already improved the quality of life of many thousands of South Africans who do not have piped water in their homes. By April this year, over 33 000 rollers had been distributed across 17 countries, directly benefiting in excess of 250 000 people. Some 95 per cent of the rollers are donated or sponsored by corporates as part of their social responsibility programmes.





JOULE

In 2008, South Africa designed its first electric family car, the Joule, which is powered by electricity. This lively little four-door car is designed to travel at speeds of up to 135 km/h and has a range of about 300 km between charges. The lithium-ion battery needs to be charged for about seven hours from a wall socket when empty, but motorists can expect to save up to 80 per cent on fuel costs and 50 per cent on service costs. This is because Joule's electric motor is much more efficient than a normal internal combustion engine. It also has fewer moving parts and is therefore considerably cheaper to maintain. The Joule produces zero tail-pipe emissions, which helps to reduce greenhouse gas emissions in the transport sector, one of the biggest contributors to global warming.



GREATHEAD SHIELD

James Henry Greathead was born in Graham's Town in 1820, attending school there and in Cape Town before completing his education in Britain. Moving to London in 1864, he served a three-year pupillage with the civil engineer Peter Barlow, during which time he was introduced to the shield system of tunnelling. In 1869, he and Barlow began work on designs for the Tower Subway under the Thames.

Greathead's design for a circular tunnelling shield was inspired by Barlow's ideas for a circular tunnelling shield: it consisted of an iron cylinder 2,21 m in diameter and fitted with screw jacks that enabled it to be jacked forward. In use, the shield was inched forward as the working face was excavated, while behind it a permanent tunnel lining of cast iron segments was fitted into place – itself an important innovation. This picture shows underground tunnelling work in progress on the Southgate Extension of the Piccadilly line.

Source: Wikipedia.org

- If you plan to visit London soon, be sure to take in the London Transport Museum's "Sense and the City" exhibition, which runs until 18 March next year.



PLAYPUMP

A brilliant South African invention, the PlayPump turns the boring chore of pumping water by hand into a fun activity for children. Ronnie Stuiver of Delmas, in Mpumalanga, adapted a children's merry-go-round to pump water in rural areas. The mechanism converts the rotary movement of the merry-go-round into the reciprocating movement of a water pump, using only two moving parts. This makes it highly effective, easy to operate and maintain, and every economical. PlayPumps are now used in many African countries.



COBB COOKER

Brainchild of industrial designer Ken Hall, the award-winning Cobb portable cooker was initially designed as a safe alternative to dangerous paraffin stoves, commonly used by people in rural areas who lacked access to electricity. The first prototype was a ceramic sphere-shaped device that cooked well, but was heavy and cumbersome. The initial fuel source for the Cobb was dry corn cobs – hence the grill's name. The cooker has since been refined over and over, resulting in a small, eco-friendly, portable and highly efficient portable cooker. Compressed charcoal briquettes have replaced the corn cobs.



VIBÖL EXHAUST VIBRATION BALANCER

The Viböl Exhaust Vibration Balancer was invented in 1996 by Jacobus Cronje of Cape Town. It manages all known movements in an exhaust system and thus reduces fuel bills and breakages. The system was developed by Cronje after customers requested something different from the standard flexible joint (which attaches the exhaust system to the engine), as this often cracks.

The Viböl system can swivel 17 degrees in any direction, whereas the flex, spiral and slip arrangements that are normally used in exhausts have a very limited swivel. The design consists of two sections that taper. Diesel gas emissions released into the air are high in carbon. This turns into graphite when it is hot, and the emission gas forms a further seal (graphite is also good at reducing friction and helps the moving parts to last longer). In 2002, Cronje signed a R450 million deal with a US company to make and export the Viböl Balancers, which are now used in trucks, ships and diesel generators worldwide.

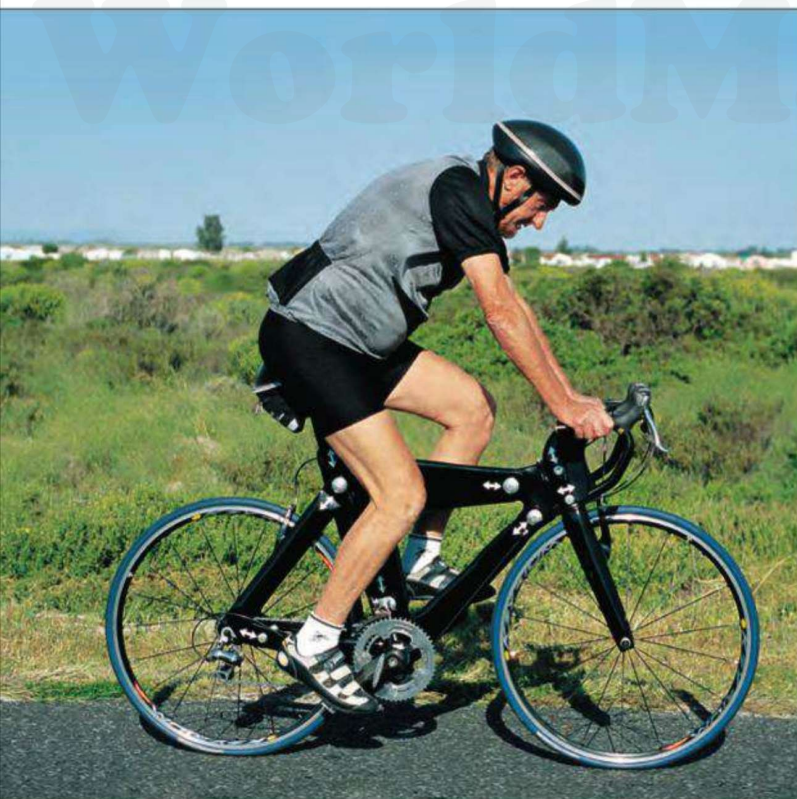
INTERNET SECURITY SYSTEM

South African Mark Shuttleworth, the first African in space (he took a \$20 million ride on a Russian-built rocket and spent a while orbiting Earth aboard the International Space Station), started his Internet security business in his parents' garage after graduating with a business science degree from the University of Cape Town in 1995. He became extremely rich when he sold the Thawte Internet security system to VeriSign in 2000.



tthawte

Shuttleworth is founder of the Ubuntu Project, a popular Linux-based operating system that is freely available worldwide for desktops and servers. According to his official biography, Ubuntu aims to be "beautiful, easy to use and precision-engineered for consumers and large-scale enterprise deployments alike". Shuttleworth, who now lives on the Isle of Man, leads design and product strategy at Canonical Ltd, the company behind Ubuntu.



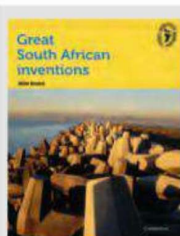
REVOLUTION PROJECT

Graeme Murray, a multi-talented inventor and keen cyclist (he's also an old friend of PM, and was a presenter at our inaugural PM Inventors Conference in 2009), is the brains behind an innovative – in fact, downright revolutionary – racing bicycle known as the Revolution Project. Featuring a carbon Nomex honeycomb and balsa core, this lightweight two-wheeler gives new meaning to “adjustable”; even the fork and handlebar can be adjusted to suit the rider's size and preferences.

Murray also invented the widely acclaimed Orthoped Bicycle Saddle, a design that takes into account the anatomical idiosyncrasies of both male and female riders; a “competition cycle crank”, an adjustable crank, and (with friend Werner Vogler) a continuously variable bicycle transmission.

FOUR-WAY FIN SYSTEM

In 2001, Cape Town's Dean Geraghty invented the Four-Way Fin System for surfboards. Normally, the fin is fixed to the end of the surfboard to prevent it from sliding sideways. The four-way system allows the surfer to adjust the position and angle of the fins according to the hydrodynamics of the surfboard, the way the surfer stands on the board, and the prevailing surf conditions. Surfers slide the fins forward to increase manoeuvrability, and backwards or inwards to improve stability. The system – the first of its kind – is now sold internationally, and Dean has gone on to become a widely respected surfboard shaper. He plans to relocate to Queensland, Australia, early next year.



Extracted from *Great South African Inventions* by kind permission of Cambridge University Press.

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solve problems,
geniuses
prevent them.”

albert einstein

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TOTAL PRIZE MONEY:
R130 000

THE FACTS

- The one-day PM Inventors Conference and awards dinner take place at the Indaba Hotel and Conference Centre in Midrand (Gauteng) on 24 November 2011.
- Only 100 seats are available for the Inventors Conference at a cost of R1 000 each.
- Only 60 seats are available for the conference *plus* awards dinner at a cost of R1 200 each.
- These prices are applicable until 31 October. Thereafter, the fee increases to R1 200 for the conference and R1 400 for the conference *plus* awards dinner.
- All bookings close on 20 November 2011.

YOUR NEXT STEP?

Find competition entry details and conference booking forms by following the links on our Web site (www.popularmechanics.co.za), our Facebook page, our weekly newsletters ("The Cutting Edge") and other media channels.

Calling all inventors

Want to win a cool R20 000? Or better still, R50 000?

If your invention is judged the best in our exciting competition, you could walk away with cash prizes totalling R50 000 *plus* the title of **Inventor of the Year** for 2011. POPULAR MECHANICS, South Africa's leading science and technology title, is looking for South Africa's **Inventor of the Year** – and it could be you! **INVENT 2011** is a groundbreaking initiative encompassing the annual **PM Inventors Conference** and a competition aimed at identifying and rewarding South Africa's top inventors.

COMPETITION

The five entry categories are: **Stepping Up** (high schools), **Breaking Ground** (university students), **Emerging Genius** (previously disadvantaged and minimally resourced entrants), **Going Green** (for inventions in the field of sustainable energy and environmental conservation), and **Cutting Edge** (open to the general public). Each category winner, as assessed by a panel of judges, will receive a cash prize of R20 000, and the overall winner will receive an additional R30 000 *plus* the title "Inventor of the Year". The winners will be honoured at a formal event on the evening of the PM Inventors Conference.

CONFERENCE

Our third annual **PM Inventors Conference** brings together some of the country's finest minds for a full day of practical and inspiring presentations.

Our presenters include:



- **Don MacRobert**, the highly respected intellectual property expert and co-author of the book, *From Edison to iPod*, will speak about some of the most pressing issues affecting today's inventors.



- **Brian Steinhobel**, the widely travelled and formidably talented industrial designer and product developer, will unveil some of the lesser-known truths of the design industry.



- **Professor Deon de Beer**, executive director of Technology Transfer and Innovation at the Vaal University of Technology and founder of the Centre for Rapid Prototyping and Manufacturing (CRPM) at the Central University of Technology: "DIY prototyping."



- **Simon Gear**, a director of Kijani Green Energy, expert in corporate sustainability and modern environmental thought, and anchor of South Africa's premier environmental TV show, 50|50: "Inventing for a sustainable future."



- **Errol Braithwaite**, Technical and Marketing Executive for Bombela – the company contracted to design, build and operate the Gautrain Rapid Rail Link: "Building Gauteng's transport future."



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HYBRID MUSCLE

M55 Terminus

Meet a bicycle that blows conventional two-wheelers out of the water. It's the M55 Terminus, a limited-edition "hybrid" bike resulting from four years of development and six stages of evolution. Why do they call it a hybrid? Easy – because it's propelled by a mix of human muscle and a powerful electric motor that provides just as much (or as little) assistance as required.

A speed reduction gear is integrated in the motor unit to deliver anything from 54 to 90 N.m of torque, offering a theoretical maximum speed of 67 km/h (the heavier the rider, the slower the ride). Created by a forward-looking Hungarian company called M55, this beautifully engineered cross-country bike features a built-in sensor that measures the rider's cadence and activates the motor automatically to multiply his or her effort.

It comes in three versions: the White Brothers Edition, the Biceps Edition and the Tailor-Made Edition (featuring a custom airbrush paint job), with a starting price of around R270 000. If this sounds like rather a lot of money, take heart from the fact that you will probably be the only person in the country to own one. Oh, and you get a free GPS as part of the deal.





EXTREME AND GREEN

Husqvarna Concept E-go

They bill it as "80 kg of pure exhilaration", and they may have a point. As electric motorcycles go, this one is rather eye-catching, with its single-sided, double-leg fork and aluminium single-sided swingarm. It's aimed at young riders on the lookout for a machine that offers on-road, off-road and supermotard experiences in one svelte package.





VIDEO

> Visit www.popularmechanics.co.za to catch the Sealander in action.



CAMP ON WATER >>>>>

Sealander Amphibious Camping Trailer

If you've ever dreamed of a holiday that combines camping with cruising (haven't we all?), you might consider this compact, German-designed floating caravan. You can park it on the river bank while you're having a braai, then slip it into the water and potter around a dam or river – using a clip-on electric outboard – to your heart's content.

The modular interior allows a variety of sleeping, seating and storage configurations. A modest 389 cm in length, and weighing 380 kg, the Sealander comes with a double hull and is intended for use in shallow waters. However, designer Daniel Straud says he's working on a model for deeper water, and even plans a seagoing version.



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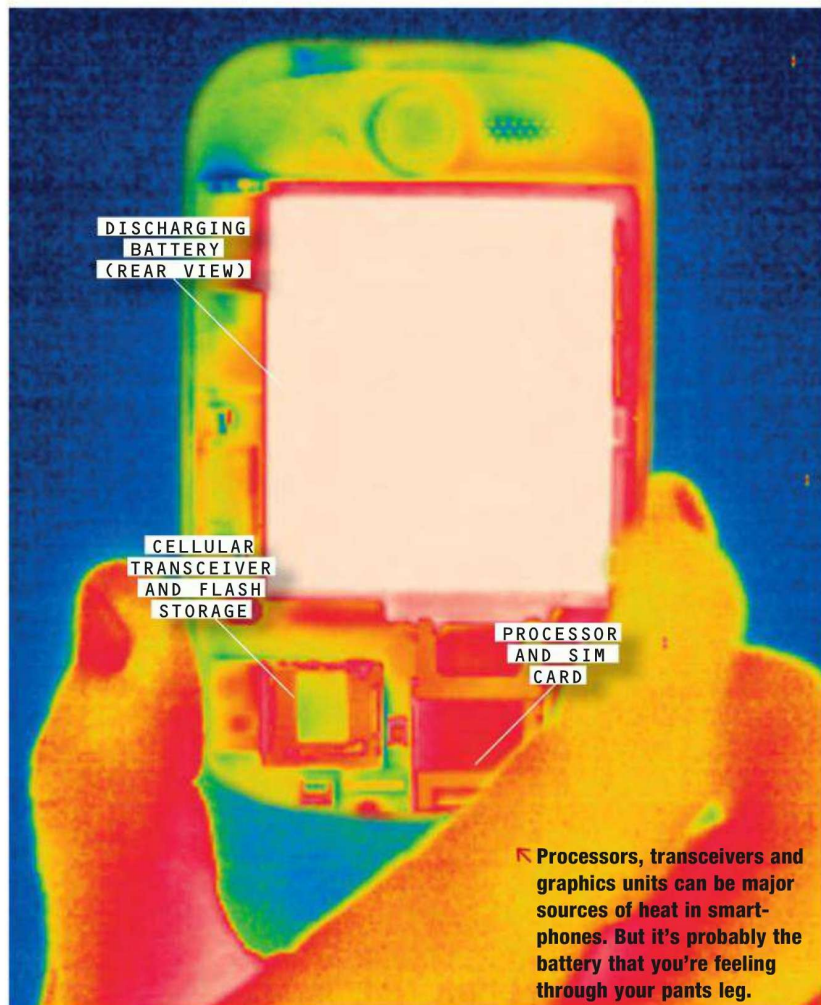
HOT pockets

Q My smartphone gets hot. Not so hot that it burns my hand, but close. Is something wrong?

A Little heat from an electronic device is normal. It's an unavoidable side effect of charging, discharging, processing and illuminating. Stick your hand behind the ventilation grille of an HDTV or a cable box, or feel the bottom of your laptop. These things are like space heaters.

Just because gadget heat is normal doesn't mean it's good. To a user, excessive warmth emanating from a device may be irritating or even alarming; to the gadget – in particular, its battery – heat is a mortal threat. "Heat is a killer of all batteries," says Isidor Buchmann, CEO of battery-testing firm Cadex Electronics.

He's not exaggerating: according to his research, a lithium-ion battery stored



at 40 per cent charge and 40 degrees – a realistic temperature for common cellphone use – will lose 15 per cent of its capacity over the course of a year. That number jumps to 35 per cent if the battery is stored at full charge, as in the case of a laptop that's left plugged in all day.

So, what, if anything, can be done about an overheating gadget? There are three common causes of a feverish phone: poor signal, intense workload and battery charging. There isn't much you can do about a poor signal. Smartphone operating systems are fairly good at keeping renegade software in line, but it's worth checking to see if there are any apps running in the background. The most likely culprit is actually a phone's case – especially if it includes a battery pack of its own. Let your phone go nude for a day, and see if that helps.

A scalding laptop can usually be explained by either an overactive processor or poor ventilation. Press CTRL+ALT+DELETE on a PC or open the Activity Monitor app on a Mac to check if any programs are straining the processor, then close or uninstall the worst offenders. Propping up a hot laptop to improve airflow will go a long way, too: some laptops, such as Apple's, use their entire bodies as heat sinks.

Lastly, take a peek inside your computer's exhaust or intake ducts. A dust build-up can result in severe overheating. If you're willing, you can partially disassemble your computer and clean with compressed air or a fine brush.

If a gadget's temperature gets out of hand, the device will usually attempt to save itself. A laptop will simply shut off without warning; smartphones will display a visual warning, then power down. If the problem persists, contact the manufacturer – persistent or extreme heat could be a sign of thermal runaway, which can result in a burst battery.

THE ACCIDENTAL PIRATE

Q My family and I don't illegally download movies or music (as far as I know, at least). We do, however, use a ton of bandwidth – gaming, music streaming, etc. I read that Internet service providers are cracking down on downloaders and pirates. Does that change anything for us?

A Unless your kids are sneakily downloading movies on BitTorrent, then, no. The USA's new Copyright Alert anti-piracy system is a standardised warning system, designed by ISPs and that country's Centre for Copyright Information – a coalition of film, music and TV companies – targeted at people who actively share content illegally.

The new system works like this: a content owner notifies an ISP that one of its users is hosting illegal material on BitTorrent or a similar service; the ISP warns said pirate that he's been caught; if the pirate doesn't cease and desist, the ISP throttles his connection to 56K modem speeds until he does. **PM**



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RULES: This competition is open to all South African residents except employees of Vespa, RamsayMedia and businesses associated with this promotion. The winner must be over the age of 18 and in possession of a valid motorbike driver's license. Prizes not claimed within 3 months will be forfeited. The prize is not transferable, nor can it be converted into cash. The Riding Academy lessons are offered in Cape Town or Johannesburg only. The prize vehicle must be collected in Johannesburg or Cape Town at the winner's expense and the colour may vary from image. The winner may have promotional photographs taken with the prize for publicity purposes. The closing date is 30 November 2011 and the winner will be contacted telephonically by RamsayMedia. The judges' decision is final and no correspondence will be entered into.

BY DOUGLAS FOX

SUPER STORMS



ILLUSTRATION BY JESSE LENZ



VIDEO

> Visit www.popularmechanics.co.za to watch a retrospective video showing Hurricane Katrina as captured by satellites. Also watch a video that takes you up close and personal with Hurricane Katrina.

Hurricane Irene's destructive trail re-opened the still fresh wounds of 2005's Katrina — and brought home the realisation that it's time to face the new high-hazard reality and get prepared.



THE HURRICANE CHURNING OFF THE EAST COAST OF NORTH AMERICA SEEMS DESTINED FOR THE MID-ATLANTIC. THEN A COLD FRONT DESCENDING OUT OF CANADA NUDGES THE CATEGORY 2 STORM NORTHWEST INSTEAD – SETTING IT ON A WORST-CASE COURSE FOR NEW YORK CITY.

New York Harbour has often sheltered the city, dissipating energy from violent gales that start at sea. But now it plays an opposite role: it turns an otherwise moderate hurricane into a disaster. As the eye of the storm passes over Staten Island, the 150 km/h counterclockwise winds shove 500 million tons of seawater directly into the harbour. The narrowing shorelines and shallowing sea bottom cause the mass of water to build. By the time the storm surge washes over the shores of Brooklyn, Queens and Manhattan, it towers 3 to 5 metres high.

Water flows through New York's financial district and reaches 3 kilometres southern Brooklyn and Queens, flooding 4 600 km of roads. Impromptu rivers gush into subway stations and pour through hundreds of sidewalk gratings.

In Manhattan, the lower levels of Penn Station and Grand Central fill with water. The subway floods within 40 minutes – paralysing the city's chief form of public transportation. Three of the four vehicular tunnels linking Manhattan to the outer boroughs and New Jersey also flood, submerging hundreds of cars stranded in traffic jams during evacuation. A million people lose electricity and phone service as floods shut down 10 power plants and the emergency generators powering cell-phone towers.

While this scenario may sound like yet another apocalypse-in-New York summer blockbuster, it was produced using calculations from the US Army Corps of Engineers – and it's been given serious attention from government planners. That 1995 Army Corps report and a 2006 analysis by the US Department of Homeland Security predict that a Category 4 hurricane scoring a direct hit on New York City would inflict R3,5 trillion worth of damage – quadruple that wrought by Category 5 Hurricane Katrina in 2005.

A third study, released this September by New York state, predicts that an even milder, Category 1 hurricane

New York City

According to the Metro New York Hurricane Transportation Study, an analysis by the US Army Corps of Engineers, a Category 4 hurricane could inflict R3,5 trillion in damage. SLOSH computer models from the city's Office of Emergency Management show that a direct hit by even a Category 2 storm would completely inundate Rockaway Peninsula; a Category 3 storm would put JFK airport under 6 metres of water.



SEVERE STORM WARNING

or winter nor'easter could inundate the city's subway and cause R400 billion in losses. Experts don't consider such disastrous flooding a mere possibility; they believe it's a certainty – a one-in-100-year event. Sea level rise will upgrade it to a one-in-35-year event by 2080.

"We've been very, very lucky because we haven't had that (direct hit)," says Cynthia Rosenzweig, a climate-impact scientist at the Nasa Goddard Institute for Space Studies in New York who has helped guide the city's storm- and climate-planning effort. "But the potential vulnerability for that is very high."

Every region of the US is subject to catastrophic storms of one type or another. Although the severe floods and tornadoes that devastated large swaths of the country in recent months surprised many people, there's no reason they should have. Annual losses from natural hazards have increased several-fold over time – costing the nation R4 trillion in crops and property since 1960. Americans are turning even routine storms into full-blown disasters by settling where they strike. Then, when vulnerable infrastructure is swept away, people have exhibited a steadfast commitment to rebuilding it.

"There are more people living in what we might consider to be high-hazard areas," says Susan Cutter, a disaster scientist at the University of South Carolina in Columbia. These include coastal areas, floodplains and places especially prone to tornadoes and landslides. By 2040, 70 per cent of the US population – which should then number 400 million – is expected to concentrate in 11 megaregions, seven of which occupy coastal counties.

If New York – part of the Northeast megaregion – suffers a direct hit, workers will spend weeks pumping several billion litres of brackish water out of its

subway and train tunnels. The salt will corrode power lines, transformers and thousands of brakes and switches that control the trains. Some subsystems could take a year or more to restore.

To avoid such a scenario, New York state recommends the city invest well over R700 million a year in storm protections. City planners are already experimenting with dozens of low-tech fixes, says Adam Freed, deputy director of the Mayor's Office of Long-Term Planning and Sustainability. These include raising subway vents above sidewalks, installing barriers several centimetres high around subway entrances and using porous roadways. They've also considered building lips around rooftops to slow the percolation of water into streets and sewers, because every centimetre of rain that falls on New York translates to about 2 billion litres of storm water that must be managed.

Some observers, such as Malcolm Bowman, an oceanographer at the State University of New York at Stony Brook, have even suggested that four

CATEGORY 3 HURRICANE



massive barriers be built across the waterways surrounding the city. The arms would swing shut during severe storms – much like those of the Maeslantkering, a barrier that protects the Port of Rotterdam from surges in the North Sea.

CANTON, A TOWN OF 2 500 on the upper Mississippi River in Missouri, has been at the centre of an increasingly high-stakes environmental wager for years now. In the summer of 1993, a high-pressure system stalled over the southeastern US, forcing the jet stream, laden with moist air from the Gulf of Mexico, to the north, where it collided with cold air from Canada. As a result, rainstorms drenched the upper Midwest. Many towns received two to six times the normal amount of rainfall for June and July.



In 2010, the Insurance Institute for Business & Home Safety Research Centre tested two different home-construction methods against hurricane-force winds.

1 | Heat Engine

Hurricanes are massive dynamos powered by the evaporation of water and its subsequent re-condensation into clouds and rain. Each litre of water that evaporates and condenses carries about as much thermal energy into the atmosphere as that contained in about a quarter cup of petrol.

2 | Hotspot

Hurricanes spawn over patches of ocean where the surface water has warmed to at least 27 degrees down to a depth of at least 50 metres. Ocean water evaporates in these hotspots and the moist air rises.

3 | Updraft

The rising of warm, moist air creates a low-pressure zone, pulling in more air from nearby areas, which also moistens and rises. The continued updraught is fed by condensation of evaporated water into clouds and rain. The condensation dumps energy back into the air, warming it and making it more buoyant.

4 | Spiral

Surrounding air flows into the low-pressure zone in a spiral pattern. This inward-spiralling air forms the hurricane's destructive winds. The direction of the spiral is determined by the Coriolis effect – a byproduct of the Earth's rotation.

5 | Sinking

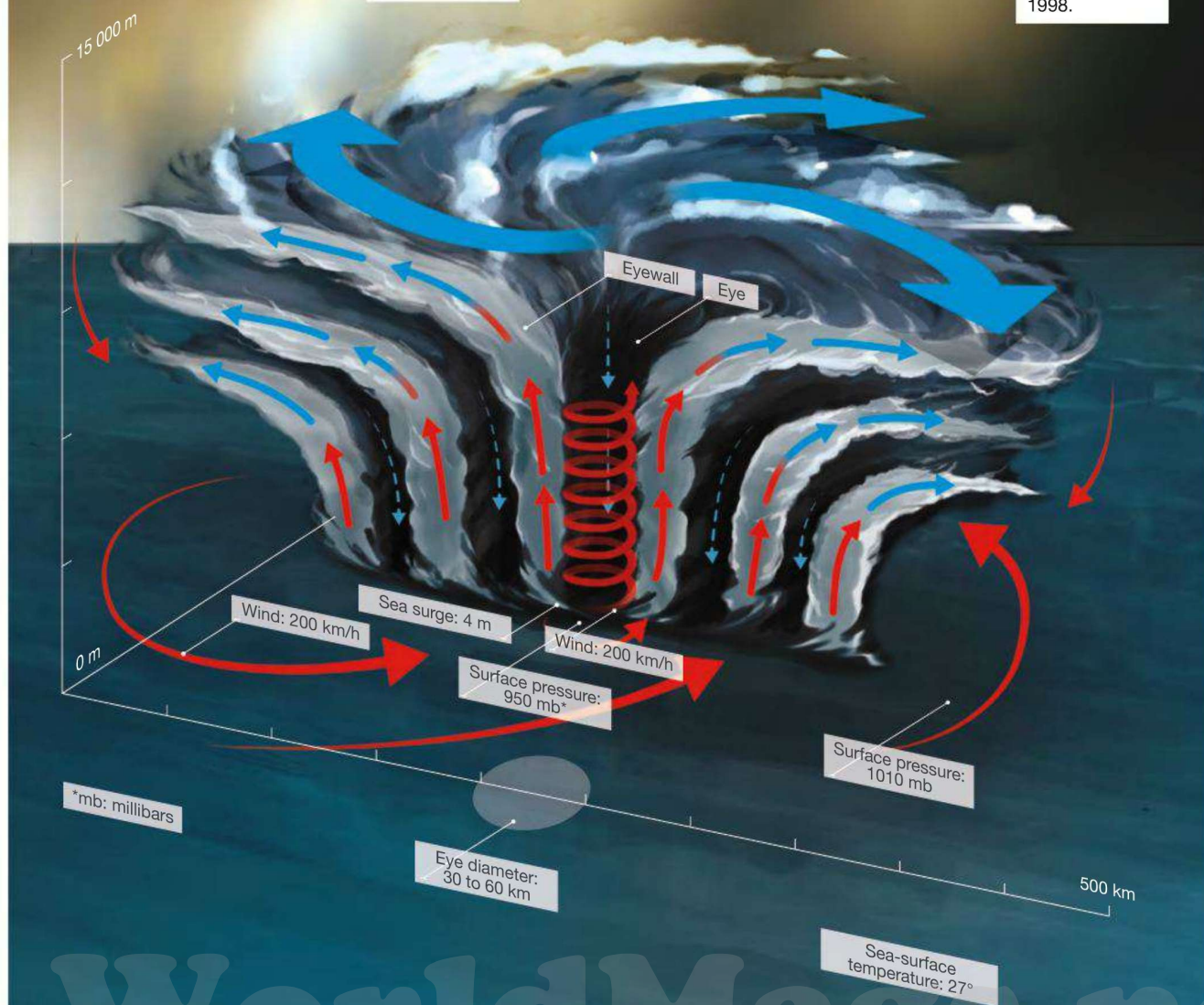
Air is ejected from the top of the storm at an altitude of about 12 000 metres. This cooled, dried air sinks through the eye of the storm or else flows out and sinks in the outer bands of the storm, forming areas without rain.

6 | Magnitude

At its peak, a hurricane can dump 20 cubic kilometres of rain a day and unleash thermal power (freed by condensation of that water) at a rate of 6×10^{14} watts – equal to 200 times the amount of electricity generated by humans worldwide. Only about 0,25 per cent of this power is converted to wind.

7 | Effects

In addition to destructive winds, hurricanes can pile up sea surges higher than 6 metres (which are responsible for most deaths). Even after winds dissipate inland, rain can cause flooding for days – as happened with Hurricane Mitch, whose floods and mudslides killed nearly 20 000 people in Central America in 1998.



ILLUSTRATIONS BY KIJi MCCAFFERTY

FLOOD



The Mississippi River crested at 4,2 metres above official flood levels in Canton, overtopping several local levees.

That year, more than 1 000 levees ruptured or overflowed along the Mississippi and Missouri rivers. Seventy towns, including Canton, flooded. The water stayed high for six months.

According to US government statistics, the flood that Canton experienced in 1993 was a freak, one-in-500-year event – not something that would happen again soon. That estimate came from analysing the 140-year historical record – calculating the frequency of floods of various magnitudes and extrapolating the curve out to events at a scale never seen before.

If only it were that simple. Canton suffered another 500-year flood in 2008, a 70-year flood in 2001, and 10-year floods in 1996, 1998 and again in early 2011. Plenty of towns across the region have suffered similar events.

"We're witnessing higher and higher floods over time," says Robert Criss, a hydrogeologist at Washington University in St Louis. "We are seeing higher and far more frequent floods than government estimators say we should."

The data are too noisy to chalk that trend up to increased rainfall. Instead, official statistics may underestimate the severity of floods in this region because records are too short to reveal the full variability of the climate. "We have no idea what Mother Nature is capable of dishing out," Criss says.

PEOPLE TEND TO view earthquakes and hurricanes as the most damaging natural disasters – but a steady rain could do far worse. In the winter of 1861 to 1862, California experienced a series of rainstorms lasting 45 days. The Central Valley, the large, flat plain running down

PREVENT
FUTURE
DAMAGE

Improved statistics Flood-risk statistics for the upper Mississippi River seriously understate the potential for flooding. In St Louis and dozens of smaller cities and towns, a one-in-200-year flood may actually occur every 50 years. Correcting those risk numbers could raise flood insurance rates, curb development in high-risk areas, and ultimately reduce federal government flood insurance payouts.

Coastal buffers During the 2004 Indian Ocean tsunami, mangrove trees as little as 100 metres deep blunted tsunami flow pressure by up to 90 per cent. Development has substantially reduced mangroves that naturally occur along the US Gulf Coast from Texas to Florida; restoring them could help protect coastlines against hurricane storm surges.

Proactive mapping Coastal cities need to retool zoning laws to incorporate the 60 to 120 centimetres of sea-level rise expected by 2100. Jonathan Overpeck at the University of Arizona has produced elevation maps of 180 coastal US cities – on average, almost 10 per cent of their area will be inundated by 1 metre of sea-level rise – with larger areas at risk of floods or extreme tides.

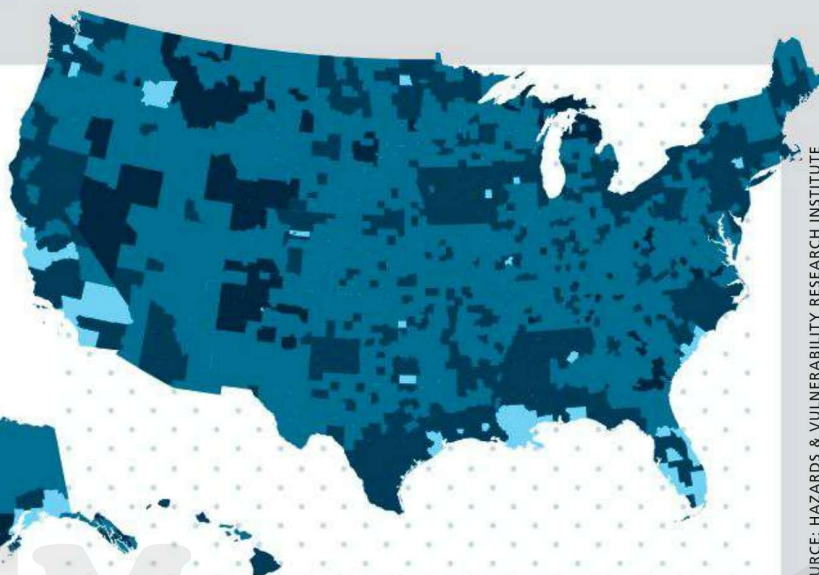
Handheld warnings Quicker flood warnings could help people react in time. The US Geological Survey is developing smartphone apps that track users' locations and warn them if a flash flood is headed their way. The apps could become available within five years in flash-flood-prone areas.

Floating structures In areas where floods are a problem but wind, waves and strong currents are not, one solution is to build infrastructure that floats. In New York City, for example, several oil-fired power plants on floating barges provide electricity during peak demand. These "power barges" can move upriver during storms and then restore power after the surge has passed.

THE
COST OF
INACTION

(IN MILLIONS)

There were 1 764 US presidential disaster declarations due to natural hazards – such as severe weather and wildfire – between 1960 and 2009, costing the country R1 trillion.



SOURCE: HAZARDS & VULNERABILITY RESEARCH INSTITUTE

The Maeslantkering storm-surge barrier, in the Netherlands' New Waterway, automatically swings shut to protect the Port of Rotterdam against severe flooding from the North Sea.



the middle of the state, became a shallow lake that lingered for months. Newspapers described people travelling the streets of Sacramento in boats.

A team of 40 scientists recently modelled the effects of such a roughly 500-year storm if it were to strike California today. "There's no way that the magnitude of the storm and the subsequent flooding could be contained by the existing flood structures," says Justin Ferris, a hydrologist at the US Geological Survey's California Water Science Centre in Sacramento. "Such a flood would be devastating."

Ferris and others estimate that a 500- by 30-kilometre swath of the Central Valley would flood. Waterlogged soil would trigger hundreds of landslides. While the USGS considers a magnitude 7,8 earthquake along the San

Andreas fault an equally likely event, the California storm would cost nearly three times as much – R3 trillion in direct damages.

Plenty could be done to soften the impact of massive downpours, but it will mean undoing 150 years of misguided policy. Engineers have progressively walled in the upper Mississippi and lower Missouri rivers as they straightened them for ship navigation – in some places decreasing the rivers' width by two-thirds since 1875. This reduced their ability to expand during floods. Compared with a century ago, an equivalent amount of water flowing down the upper Mississippi River now causes the water to rise 3 to 4 metres higher.

In Chesterfield Valley, Missouri, malls and homes worth several trillion rand have been construct-

ed in the past decade on land that was underwater in 1993 – requiring the government to build up levees. Breaking that cycle, Criss says, will mean putting an end to misleading flood-risk statistics and the artificially cheap federal flood insurance that goes hand in hand with them. "It enables people to obtain financing for very economically damaging projects," he says. "It puts the taxpayer on the short end of the stick."

You might say the Army Corps of Engineers took a small step in the right direction on 3 May, 2011. That's when it dynamited a 3-km section of levee on the Mississippi River to divert water onto farmland and save the town of Cairo, Illinois, from flooding. But the ensuing wall of water inflicted long-term damage – scouring away topsoil, gouging gullies 2,5 metres deep and dumping sand.

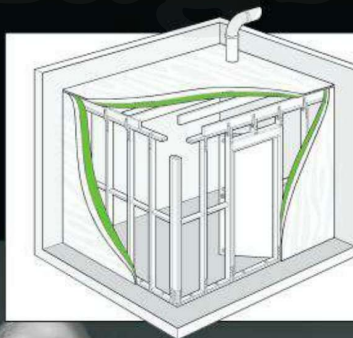
A better approach is to plan for flooding by building lower levees that are designed to overflow, allowing the farmland to flood more often – and more gently. "We need a system that uses farmland for floodwater storage," Criss says. "It will help the environment, and the farmers can be compensated for that, just like we compensate them for letting land lie fallow." Such a system would pay for itself by reducing rebuilding costs; flood damages currently total R7 billion to R70 billion a year in the US.

FLOOD AND HURRICANE risk can at least be predicted: it is heavily influenced by topography, and the storms and floodwaters can be tracked for days in advance. But severe tornadoes, like the ones that tore across the central and eastern US in 2011, pose a very different challenge.

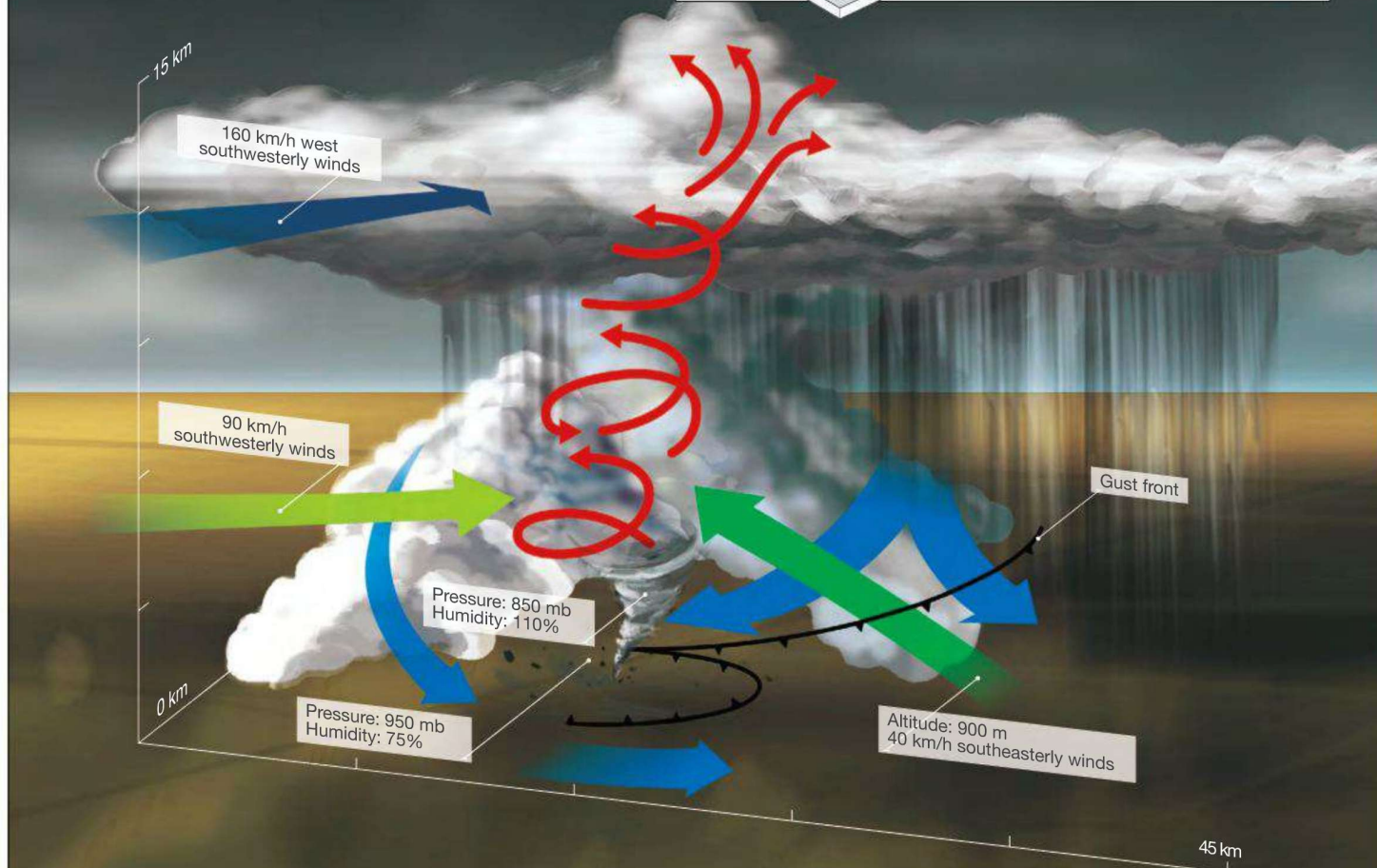
The tornado that ripped through Joplin, Missouri, on 22 May, a 5 on the enhanced Fujita (EF) scale, existed for just 38 minutes. During that time it ploughed a path 1,2 km wide



EF4 TORNADO



Researchers at Texas Tech have developed plans for DIY storm shelters made by pouring concrete into foam forms. The walls are two layers of plywood and one layer of 14-gauge steel. The doors close with triple deadbolts, and ducts equalise the pressure inside and out.

1 | **Supercell**

Tornado-spawning thunderstorms, called supercells, arise where a current of low, warm, moist air travelling north from the Gulf of Mexico flows underneath a higher, cooler mass of air travelling east. Shear from these opposing winds causes the entire supercell to rotate slowly.

2 | **Updraught**

The low, moist air is warmed by sunlight, making it increasingly buoyant. The moist air breaks through the cooler air above and rises. As it does so, vapour condenses into water droplets – dumping the heat of condensation back into the rising air, warming it and further feeding the updraught that will ultimately power the tornado.

3 | **Downdraught**

The updraught is counterbalanced by a downdraft of sinking air, which is cooled by rain. This cool, sinking air next to warm, rising air produces a pressure gradient in the bottom 1 000 metres of the atmosphere, lending a spiralling motion to the updraught – which will become the tornado.

4 | **Stretching**

The supercell travels northeast, towing the updraught like a leash. Stretching causes the updraught to narrow. As this occurs, its spiralling winds accelerate – much like a spinning ice skater speeding up as she pulls in her arms and legs. A violent tornado is born.

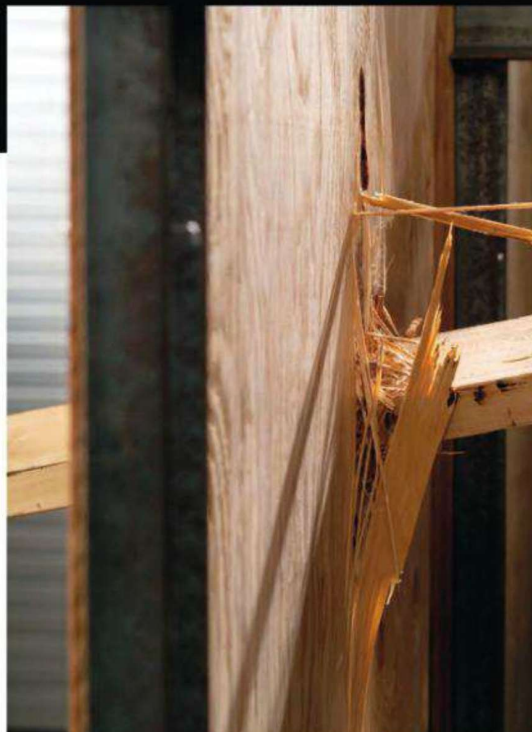
5 | **Pressure**

The tornado's updraught creates a low-pressure zone at its core. That pressure differential relative to the surrounding air is roughly equal to that of a Category 5 hurricane – except that in the case of the tornado, the differential exists within a kilometre rather than 150 kilometres – helping fuel ferocious winds that can far exceed those of a hurricane.

6 | **Effects**

Supercells don't just spawn tornadoes. They can also produce powerful downdrafting wind bursts kilometres from the tornado. These bursts can sometimes flip mobile homes. Supercells can also produce dangerous lightning and hail as large as golf balls or grapefruit.

By firing the "large debris cannon" in its research centre, insurer FM Global can measure the impact of objects, such as tree limbs or signposts, propelled by winds up to 210 km/h.



through town, destroying nearly 7 000 homes and tossing pick-ups 200 metres. Many people, such as Pizza Hut manager Christopher Lucas, reacted just in time: he crowded 19 people into his walk-in freezer. They survived, although Lucas – sucked out of the freezer as he held the door shut with a bungee cord – was among the 150 who died.

The tornado seemingly could have struck anywhere. The moist air that flowed from the Gulf of Mexico that day created a whole herd of potentially tornado-spawning thunderstorms, from Oklahoma to Minnesota. The Joplin tornado affected just a few square kilometres of that vast area – yet it did so with overwhelming fury. Its winds, over 300 km/h, hammered buildings with four times the pressure that a Category 2 hurricane with 150 km/h winds would have exerted.

It's possible to build a house to withstand 150 km/h winds, providing partial protection against some weaker tornadoes. But 300 km/h winds? "It's just not practical to design the entire building to withstand those kinds of pressures," says Ernst Kiesling, an engineer at Texas Tech University's Wind Science and Engineering Research Centre. "It would be

too expensive." Even if houses can't be protected from EF5 tornadoes, Kiesling has spent decades looking for ways to save the lives of the people inside them.

After a tornado killed 26 people and destroyed hundreds of homes in Lubbock, Texas, in 1970, Kiesling and his colleagues noticed a curious thing: even in buildings that were blown apart, an interior bathroom or closet was sometimes left intact. It gave Kiesling an idea: convert a small, windowless room in the house into a tornado shelter that could survive 400 km/h winds.

Many of the fatalities in tornadoes occur when people are struck by projectile debris – the Joplin tornado, for example, drove all four legs of a chair through the walls of one house. So Kiesling's team tested their shelters with a gun that fired 50 x 100 mm posts at 150 km/h (the speed at which they would be propelled by 400 km/h winds). They settled on steel-reinforced plywood to make the structures puncture-proof. Such shelters can now be installed.

Researchers are working on other technical solutions to tornado protection – for example, radar that provides earlier warnings. But societal trends continually work against even

the best of efforts. "For any intensity of tornado, you're more likely to be killed if you're in a mobile home than in a permanent home – 15 to 20 times more likely," says Harold Brooks of the US National Severe Storms Laboratory. Unfortunately, the proportion of Americans living in mobile homes has tripled since 1970 (and it is highest – about 15 per cent – in the tornado-prone Southeast).

In this sense, the problems posed by tornadoes do bear a resemblance to those of hurricanes, floods and other severe storms. Some steps needed to minimise losses, such as stricter building codes and sturdier infrastructure, are well-known. They require greater investment. Other solutions, just as important, involve choosing what not to protect. Instead of applying brute force, they'll mean removing the perverse incentives that encourage people to build in high-risk areas. Because for those who find themselves in harm's way, even modest storms can be super.

PM


SEVERE
STORM
WARNING



Shooting professional-looking photos takes more than a fancy digital single lens reflex camera (DSLR). Knowing how to harness its aperture and shutter controls, flash intensity, light metering and ISO will help bring your photography skills up to the level of your gear.

Beyond automatic

Full auto mode is fine — most of the time. But you can take better pictures by using five key manual controls.

> BY DMITRI ALEXANDER

The latest digital SLR cameras employ sophisticated light sensors and composition-analysing algorithms to routinely nail correct exposures in full auto mode. Yet amateur DSLR photos often look no better than shots from a run-of-the-mill point-and-shoot.

The reason, explains photography instructor Bryan Peterson, lies in appreciating the difference between a “correct” exposure, meaning one that’s well-lighted and not blurry, and a

“creatively correct” exposure, meaning that you actually like how the picture looks. To achieve the latter, sometimes you have to say goodbye to your friend Full Auto.

Exposure is determined by three key settings – aperture, shutter speed and sensitivity to light, or ISO – as well as by how the camera meters light and how intensely the flash is fired. For any given scene, there are dozens of combinations of these settings that will produce a correct exposure – but each alters the style of the photograph.

Taking a picture manually is like going on a road trip from Sandton to Cape Town – if you have the time, you have a choice of routes. Full auto, though, is like a GPS unit that tells you to take the N1 every time. To plot a more creative course, you need to learn the basics of manual control.

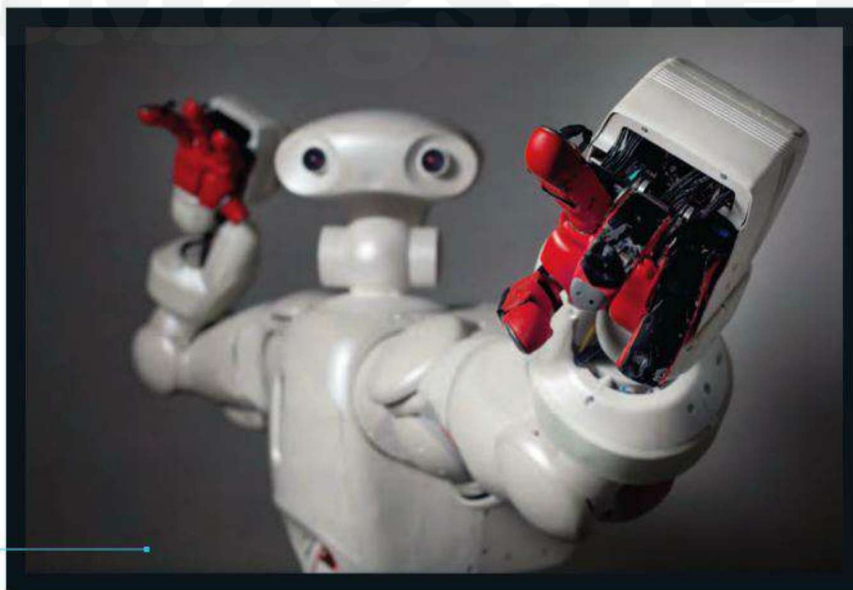
Aperture

A FOR PORTRAITS, LANDSCAPES, CLOSE-UPS, LOW-LIGHT SHOTS

➔ **Set the mode dial to A** (or Av in Canon cameras). Depending on what model you own, you’ll use either a dial or buttons to adjust the size of the aperture – the hole in the lens that controls the rate at which light passes through to the sensor. The size of the aperture is called the f-stop, and shows up as a number displayed on top of the camera or on the rear screen.

Full auto favours middle-of-the-road apertures such as f/5.6, but you’re going to want to play with the extremes. For landscape shots, like the one of Yosemite’s Half Dome on the opening page, put your camera on a tripod and select a very small aperture (one with a high number); say, f/22. That maximises depth of field so that everything from the trees in the foreground to the iconic cliff in the distance shows up in focus.

To draw attention to a particular part of the picture, though, choose a wide aperture (one with a low number), such as f/2.8 or below. In the robot photo (top right), I focused on the fingertip and shot at f/2 to minimise depth of field. Only its left hand is sharply in focus, creating the impression that this menacing machine is reaching out to touch you. Wide apertures are also great for human portraits.



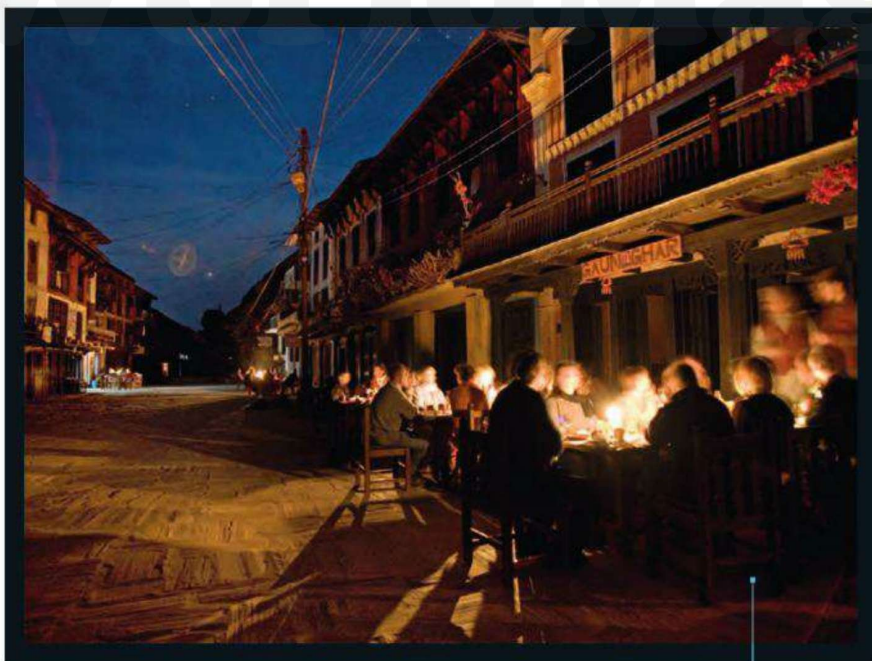
Shutter speed

S FOR NIGHT SCENES, ACTION SHOTS, IMPLIED MOTION, SPORTS

➔ **Shutter speed** determines how long the camera’s aperture stays open to admit light to the digital sensor, and full auto likes to play it safe on this front. It generally opts for middling speeds from 1/80 to 1/500 of a second, which reliably produce blur-free images. But reliable can be boring.

When photographing things that move, turn the mode dial to S (or Tv in Canon cameras). In bright light, choose a very fast shutter speed, 1/1000 or higher, to freeze action. You’ll see every little drop of spray as a whitewater raft blasts through rapids, and each clod of dirt flying from the tyres of a mountain bike.

Work the other end of the shutter-speed spectrum, too. Slow shutter speeds (1/30 or longer) allow enough time for the moving person or object to blur, conveying motion. (Stabilise your camera, preferably on a tripod, so that only the moving subject comes out blurry.) Long exposures can also produce artistically interesting results in low-light situations. For the photo above of the person twirling fireballs, I used a 3-second exposure, enough time for a few full revolutions.



ISO

ISO FOR LOW-LIGHT, ACTION SHOTS, NIGHT SCENES, FLASH-FREE SHOTS

➔ **This setting determines** how responsive the digital sensor is to light. At ISO 200, the sensor is twice as responsive to light as it is at ISO 100; ISO 400 is twice as light-sensitive as ISO 200, and so on. The trade-off is image noise: the higher the ISO setting, the more grainy, multi-coloured speckles pollute your pictures.

Sensors have become much better at night vision, but noise often becomes noticeable beyond ISO 800. Some cameras have a dedicated button to push when you want to change the ISO; others require you to use menus to make changes. For the picture of a café in Nepal (above left), I used ISO 800 and a 10-second exposure.

Flash compensation

⚡ FOR PARTY PICTURES, OUTDOOR PORTRAITS, LONG-RANGE FLASH

➔ **Full auto** sometimes goes crazy on the flash, making your friends chatting in a bar look like wax statues at Madame Tussauds (*for the record, the museum has officially dropped the apostrophe* – Editor). For more tasteful results, start by selecting a wide aperture and higher ISO. These changes will allow your camera to capture more natural light, making it less reliant on the flash.

Next, manually set the flash to fire by pressing the lightning-bolt button found on many cameras or by raising the built-in flash module. Find your camera's flash-compensation button or menu item, symbolised by a small lightning bolt with a +/- symbol next to it. You'll see a numbered scale. Try setting the flash for -1.3, then -0.7, and so on, until the lighting is appropriately subdued.

The photo of the hiker (above, top right) shows another way to use this feature. With the subject in front of you, aim at the Sun. Find the exposure-compensation control (not the one for the flash), which on most cameras is a button with a +/- symbol on it. Change it to around -1. This helps you get a blue sky and keeps the Sun from being too bright. Then dial the flash compensation to +1. The result will be an into-the-sun shot with both the subject and bright background properly exposed.



Spot meter

☑ FOR COMPLEX LIGHTING, OUTDOOR PORTRAITS, LANDSCAPES, SILHOUETTES

➔ **The shot of the Andes** (above, bottom right) presented a classic light-metering challenge – a scene containing both bright and dark elements. In high-contrast scenarios, full auto splits the difference to capture as much of the highlight and shadow detail as possible. The resulting shot is often an unsatisfying compromise.

For better results in high-contrast scenes, set the camera to the spot-metering mode, symbolised on the display screen by a dot inside a box. Then decide what's most important visually. Centre the area of interest in the viewfinder – in my photo, the sky and mountains – and depress the shutter button halfway. This tells the camera, "Give me a perfect exposure of what we're looking at right now". With the shutter still half-depressed, you can adjust the composition, then push further to shoot.

This technique left the mountaineer and foreground slopes underexposed to the point of becoming silhouettes, but that added visual punch. Compromise is overrated. So take the next exit from full-auto I-80 and have a little more fun. **PM**

Takes design to a new level
Ford Next Generation Kinetic Design

Takes bumps easily
Control Blade Independent
Rear Suspension

Takes corners precisely
Torque Vectoring Control®

Takes your safety seriously
5-star NCAP rating

ALL-NEW **FOCUS**.
Start more than a car.

Building the perfect Jeep

> BY JOE PAPPALARDO

> ILLUSTRATIONS BY RAZVAN MAFTEI

By combining ideas and tech from industry experts, our editors create the Popular Mechanics Light Tactical Vehicle (PMLTV).



Common Remotely Operated Weapon Station (CROWS)

allows troops to fire weapons from inside the vehicle by using a joystick.

Developed by Kongsberg

Gunfire detection system

can locate threats from the acoustic signature of firearms.

Developed by Raytheon

"Sweating" armour

emits water through microscopic pores in the vehicle's skin to reduce the thermal signature.

Developed by BAE Systems

Sensors enable the PMLTV to operate as an unmanned ground vehicle. Modes include follow-the-leader as well as waypoint and autonomous navigation.

Developed by US Army; DARPA

ONE OF THE WORLD'S BEST-LOVED VEHICLES developed out of a need for compact, agile and tough transport in the theatre of war. Just how fit-for-purpose the original Jeep was became apparent as it did yeoman duty in World War 2 and subsequent conflicts before it was finally supplanted by a modern equivalent dictated by the ever-changing requirements of modern warfare: the Humvee.

Those same changing requirements now make it once more necessary to update the template of a vehicle that will be called on to do everything from hauling gear to ferrying troops and conducting patrols.

Thing is, the military is having a devilishly hard time building a light tactical vehicle to replace the Humvee, which was introduced in the early 1980s. Contractors are vying to produce the next-generation all-purpose vehicle, called the Joint Light Tactical Vehicle (JLTV), for the US army and the Marine Corps. But with R2 billion already invested – and at least R4 billion more in projected development costs through 2015 – the only options thus far have been expensive, overweight prototypes.

In February, the US army's product manager of the JLTV programme revealed to attendees of a National

Defence Industrial Association wheeled-vehicle conference that each of the 21 JLTV designs submitted by contractors was as much as 450 kg too heavy. This degrades the vehicles' performance and, since JLTVs will be built to be carried by specific helicopters and fixed-wing aircraft, restricts their deployment. The cost is also rising. Replacing steel with lighter composites and metal alloys drives up the price; the JLTV options are already topping the \$300 000 (about R2 million) goal set by the Pentagon. Existing Humvees cost R525 000; with an extra armour kit, the price is around R1,5 million.

Not willing to sit by while the defence industry that created the Jeep flounders, PM took action. We called on the best military-vehicle designers to help us create the PMLTV, a rugged, menacing piece of machinery. Even if we do say so ourselves.

REQUIREMENTS
Kerb weight: 6 000 kg
Payload: 1 600 kg
Air-transportable: C-130 fixed-wing, CH-47 and CH-53 helicopters
Carrying capacity: Four crew
Armour: Bolt-on protection option for higher-risk operations



1 BLAST CHIMNEY

To save the weight of armour, the PMLTV instead uses a flue to channel energy from an explosion through the centre of the vehicle, guiding the damaging blast away from the occupants. The downward thrust produced by the blast rushing through the chimney also helps keep the PMLTV from flipping. Hardwire LLC is pitching the chimneys to the military; the Pentagon is blast-testing the tech now.

2 DIESEL-ELECTRIC POWERTRAIN

The PMLTV's diesel engine is connected to an electrical generator, which creates power for a traction motor driving each axle. This eliminates the need for a transmission and a conventional drivetrain, creating more room under the crew compartment for 360 degrees of armour. For a scout vehicle operating far ahead of the front lines, the option of switching to nearly silent propulsion is very appealing. We like vehicle manufacturer Oshkosh's ProPulse system, a 335-kW engine that can also export enough power to run a field hospital.

3 FORD F-450 FRAME

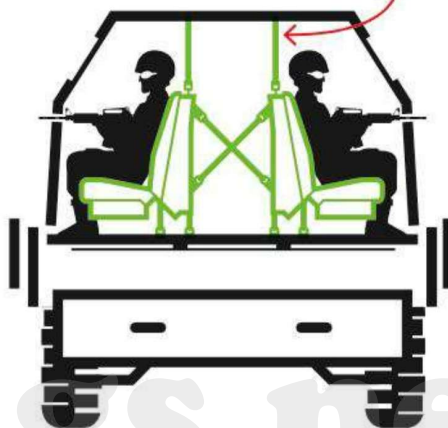
Most military-vehicle companies prefer the flexibility offered by their homegrown chassis, but purchasing an available and trusted vehicle frame from a commercial production line can save billions. In 2005, vehicle designer Scott Badenoch and the Georgia Tech Research Institute developed an armoured patrol vehicle using a Ford F-350 truck frame; we opted for the wider F-450. At about 2 300 kg, the F-450 chassis is heavy, but it can handle thousands of kilograms of payload without going over the specified 6 000-kg kerb weight limit.

4 TAK-4 SUSPENSION

It's hard to build an active suspension system that is both agile and tough enough to handle on- and off-road conditions. The F-450 suspension is certainly not up to the task, so the PMLTV adopts the new version of TAK-4, made by Oshkosh. This independent suspension system uses high-pressure gas to raise and lower the vehicle 50 cm with the flick of a switch on the front-seat dashboard. The government is now testing the new TAK-4, says Chris Yakes, Oshkosh's vice-president of advanced products.

5 CREW COMPARTMENT

Many new armoured vehicles have steering wheels in the centre of the dash, which allows greater visibility. The layout of the ballistic-resistant windows provides a better field of vision. Inside, a cage of tubular steel protects occupants during rollovers, and seats are suspended to halt the transmission of explosive shock waves to occupants.



Burn it up

CONVERTING LANDFILL GAS INTO ELECTRICITY
BOOSTS OUR RENEWABLE ENERGY MIX

> BY SEAN WOODS

As much as landfill sites are potential environmental hazards and a blight on our landscape, not everything about them is doom and gloom. Here's why: once captured, their harmful gas emissions can be converted into much-needed "green" electricity. And it gets better... South Africa is embracing this new technology, and we're getting up to speed, fast.

Living a cosy suburban life makes it all too easy for many of us to ignore modern society's dirty not-so-little secret – mountains of human-generated waste. Ugly municipal landfill sites, largely a product of our wanton consumerist ways, are here to stay, at least for the foreseeable future. However, Ener-G Systems – formed out of a partnership between local energy management company General Energy Systems and UK-based renewable energy giant Ener-G –



has found a way for us to benefit, albeit modestly, from our messy reality.

What they do, and rather efficiently, is capture the methane emissions naturally produced by decomposing landfill waste, then convert it into electricity as well as that new lucrative global commodity, tradable carbon credits.

Carbon dioxide (CO₂) may grab the headlines for its contribution to global warming, but methane (CH₄) is a much bigger villain. Twenty-one times more efficient at trapping heat than CO₂, it's also a serious health hazard. "It migrates underground and, in the right conditions, becomes highly explosive," explains Ener-G Systems' Greg Midlane. "If you can manage the methane gas emissions as well as generate power from them, that's a big plus."

Legally does it

Internationally, utilising alternative energy sources has become serious business. "Renewable energy is like the new industrial revolution," says Midlane. "The amount of interest it is generating globally is huge." On the local front, though, the main constraint on independent power producers (IPP) is a lack of legislation and tariff structure.

Fortunately, that's all about to change.

The first round of the government's IPP procurement programme (part of its Integrated Resource Plan 2010) was launched at the beginning of August. It set a benchmark of 3 725 MW of electricity to be generated from renewable sources –

wind, solar, hydro, biomass and landfill gas – by 2014. By 2030, the Department of Energy wants that figure increased to 7 200 MW.

At last, IPPs have something constructive to work with. The bidding process is currently under way and is expected to be finalised some time during November. Once the successful bidders have been chosen, they'll be able to roll up their sleeves and get down to serious business by June next year.

Getting down to business

But just because the tariff structure and legislation are not yet in place doesn't mean that the alternative energy guys have been sitting around twiddling their thumbs. The Ener-G Systems Richards Bay operation has been selling power to BHP Billiton's aluminium smelter for the past two years. "Because we've been dealing with a private company rather than a municipality on this project, it has made things much easier," says Midlane. "And, although it's a medium to small site with only a 400 kW generator, it shows what can be done."

Five landfill projects are being developed in the Johannesburg area: Robinson Deep, Linbro Park, Goudkoppies, Marie Louise and Ennerdale. Midlane hopes to have all these sites fully operational during 2012, "depending on how the negotiations with the Department of Energy go". Once completed, they are expected to generate 19 MW for around 15 years.

"That's enough to electrify about 15 000

homes," Midlane says. "A significant amount, considering that the methane would otherwise have been pumped into the atmosphere."

The potential production of Ener-G Systems' projects is a mere drop in the ocean compared with Eskom's 37 500 MW output. But consider this: it's not only a localised source of power; it's also there to be exploited. Midlane explains: "We have crunched the numbers and have worked out that, if we could capture the methane from all the landfill sites in South Africa, we would generate about 100 MW. That figure doesn't include waste water treatment works, anaerobic digestion in commercial agriculture or emissions from coal mines – areas where we have the expertise."

Of the five projects, the Robinson Deep site, located in Turffontein, south of the city, is the best developed. So far, 60 wells have been sunk (with about 100 to go as the site expands), and the captured gas is being flared into the atmosphere. At the moment, it is producing 2 000 cubic metres of gas per hour, and that is expected to increase to 3 000 cubic metres per hour once the site is fully developed.

Robinson Deep might not be producing any electricity yet (the generator module will be installed only when the official process has been finalised), but it is busy racking up some lucrative carbon credits.

This is how credits get calculated: when burned in the presence of oxygen, methane splits into carbon dioxide and water vapour. Take the methane being combusted in



Main image: A view of the Johannesburg skyline from the Robinson Deep landfill site. **Inset:** To help balance the gas flow, each well can be isolated. **Centre:** Well pipes are fed into conveniently located manifolds dotted around the landfill site, each accommodating about 10 pipes. **Left:** The gas is piped from the manifolds into the main line that encircles the entire site.



tons, multiply that amount by 21, then subtract the amount of CO₂ created. This gives you the CO₂ equivalent in tons destroyed during the flaring process that can be converted into carbon credits.

Setting up shop

Once all the relevant permits are in place, Midlane reckons it takes only about nine months to complete a landfill project from scratch. First job is to conduct a “gas resource assessment” to determine how much methane can be generated from that specific site.

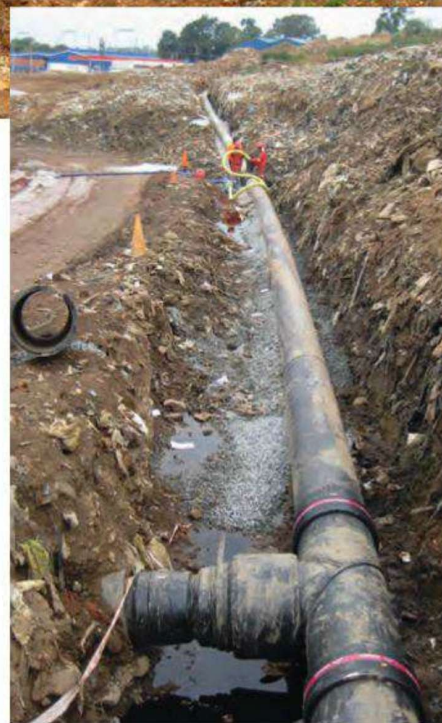
This entails looking at the amount of waste in place, future site expansion, waste composition, moisture content and climatic conditions. “We also look at the quality of the engineering of the landfill site itself and its collection efficiency. We have to ask ourselves, how much of the gas being produced are we going to be able to capture?”

All data is then captured in a computer model to produce a “gas yield curve” (against time). Only then can the potential generation capacity of the site be determined.

Once the size and number of generators to be installed are known, an electrical load study of the local distribution network is conducted. This indicates connections that can be made to the network, as well as the capacity it can handle.



Top right: Living a cosy suburban life makes it all too easy for many of us to ignore modern society's dirty not-so-little secret – mountains of human-generated waste. **Top left:** The condensation knock-out point where water is separated from the gas. **Above:** Ener-G Systems installing the condensation knock-out point. **Right:** The main gas line encircles the entire site, then enters the equipment compound via the condensation knock-out point.



Says Midlane: “Once these two studies have been completed and we can see that the project is commercially viable, we can start the full design and construction programme.”

This covers four areas – the design of the high-voltage power connection, well location and design, design of the gas



Top: Ener-G Systems' gas blower and flare units housed in the equipment compound. Generators will be installed here some time during 2012. **Above:** The point where the captured methane gas enters the equipment compound. **Above right:** Ener-G Systems' Greg Midlane.



ing your average borehole. "Drilling into a landfill mass is a highly specialised process. You don't know what you're going to hit – it could be an old mattress, wire or concrete. All of these obstructions could damage the auger or block the well."

A polyethylene pipe, anywhere from 300 to 450 mm in diameter and perforated from its base up to 6 metres from the surface, is then inserted into the well. The perforated section of the pipe is surrounded by stone to facilitate the transfer of the gas, and its top 6 metres are wrapped in bentonite clay to seal off the well from the atmosphere.

A large blower then sucks on the pipes to create a mild vacuum at each well. "This creates a bell-shaped vacuum underground, allowing us to extract the gas from the surrounding area," Midlane explains. "We leave the top 6 metres of the pipe solid because we want the vacuum to be as low down as possible. As it works in anaerobic conditions, we don't want air sucked into the system."

Well pipes are fed into conveniently located manifolds dotted around the landfill site, each accommodating about 10 pipes. To help balance the gas flow, each well can be isolated should it not generate the correct volume of methane. The gas is piped from the manifolds into the main line that encircles the entire site and then enters the equipment compound via the condensation knock-out point.

Ener-G Systems finances all its projects, conducts all the research, puts in the required infrastructure, and manages every site for its entire lifespan. It even designs, develops and manufactures its own modular generator units to ensure everything's a perfect match. "It's a perfect win-win situation," says Midlane. "We carry all the costs, derive an income out of selling the electricity and carbon credits, and the clients receive a royalty. For them it's a big swingaround because it turns a cost into a revenue stream."

Ener-G Systems intends expanding its operations countrywide, focusing first on the major centres. Once that's done, all the smaller cities with medium-sized landfill sites will be in its sights. "South Africa's a new market," says Midlane. "There's plenty of opportunity here for councils and independent waste companies to manage their methane gas emissions."

If you would like more information, contact Ener-G Systems on 031-564 0222. Alternatively, visit <http://energ.co.uk/energsystems>

collection system, and development of the equipment compound (where the gas blower, flare unit and generators are located).

Another factor to consider is that temperatures deep inside the landfill are around 60 degrees. As a consequence, gas brought to the surface is saturated with water vapour. Surface temperatures are much lower (typically around 20 degrees), so the water vapour condenses and, in a worst-case scenario, can even block the pipes. To prevent this from happening, Midlane ensures that most of the pipes run downhill with at least a 3 per cent fall, and installs a condensation knock-out point. "It's just a big sump, really," he says. "Once the water's inside, it is pumped to the site's leachate management facility, where it either evaporates or is taken away for treatment."

Drilling through rubbish isn't like sink-

Summer fun

Sun's out... let's play

SOME LIKE IT WET

Hobie's legendary catamaran, the Hobie Cat, has been providing adrenaline-induced fun for water junkies for over 40 years. But if screaming through the surf zone at breakneck speed with one pontoon pointing precariously skyward seems a tad extreme, don't sweat. Thanks to their new range of rotomoulded polyethylene kayaks – all fitted with Hobie's revolutionary MirageDrive pedalling system – you're sure to find a derivative that's perfect for you.

We check out their MirageDrive and three models from their extensive range to whet your appetite...



A TRI MADE FOR TWO

If you're looking for a fun multisport boat for two, the Mirage Tandem Island is worth a closer look. In its most elemental form, it's a fast, two-person kayak. But once you attach the two *akas* (crossbeams), the *Amas* (pontoons) and the two-piece carbon fibre rig and sailing kit (all included), two of you can go flying across the water, powered by a roller-furling, boomless mainsail.

Both cockpits have steering- and sail-control lines, making it ideal for partners of all abilities. The craft comes with generous storage space, two MirageDrives with turbo fins, adjustable padded seats with inflatable lumbar supports, and a fully-retractable, kick-up centreboard. Price: R58 000.



SPECIFICATIONS

Length:	5,64 m
Width (pontoons out):	3,05 m
Mast height:	5,49 m
Hull weight:	39,9 kg
Ama weight:	2 x 10 kg
Rigged weight:	86,18 kg
Carrying capacity:	272 kg

DON'T PADDLE, PEDAL

Hobie's MirageDrive propulsion system was born from the theory that it's easier to push something with your legs (think big muscles) than it is to pull something with your upper body (smaller muscles). The double-scissor action of the drive, apparently inspired by the study of pen-

guins, propels their hulls incredibly well.

Here's how it works: two pedals, mounted on levers forward of the kayak's seat, are attached to two underwater fins via the drive's robust, lightweight mechanism. When you pedal, the flexible fins assume the

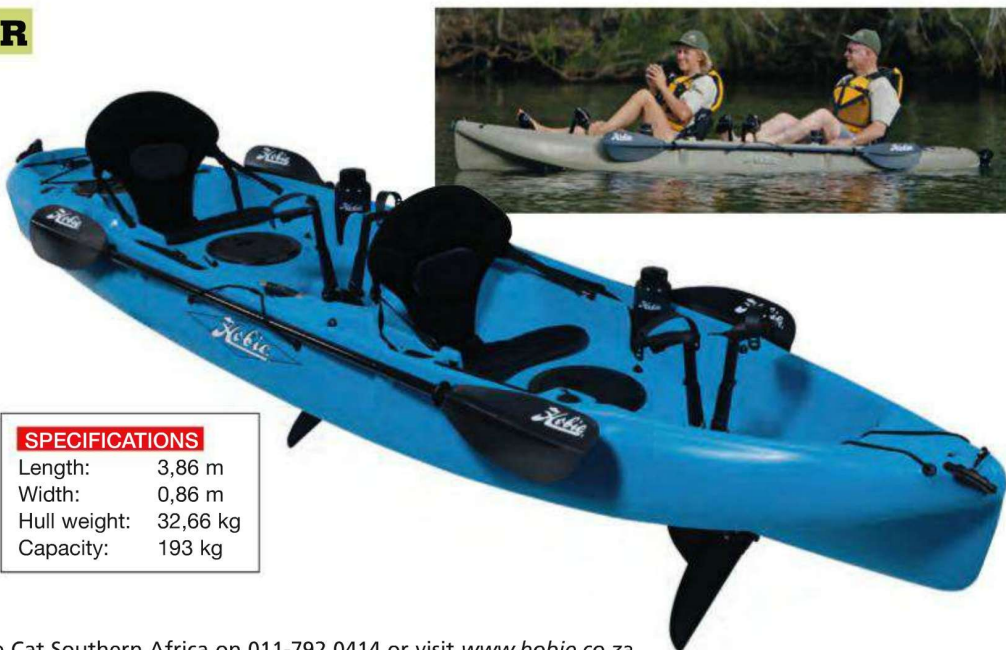
shape of a propeller blade, providing forward thrust with each stroke. And because each fin inverts its shape on the backstroke, the drive is able to generate equal power on both sides (just like a good paddler), keeping the kayak tracking evenly and moving at an efficient speed.

The fins "feather" when not in use to reduce drag, and they can be folded up flush against the hull when you're exploring shallow water or beaching. To get going, all you need do is slide the unit into its trunk, lock it in place with a "click", and you're off.

FUN MULTITASKER

Smooth, stable and built for two, the Mirage Outfitter was designed with utility, performance and ease-of-use in mind. Onboard, little features such as moulded utility trays, built-in drink holders, dual helm controls and conveniently positioned rod holders make it a pleasure to use.

Whether it's a solo after-work session or a long weekend of float casting with a friend, it boasts a wide, stable hull platform, dual MirageDrives and ample stowage space to keep you well provisioned and properly organised. Optional extras include a sail kit, bimini, dodger and plug-in cart. Price: R25 000.



SPECIFICATIONS

Length:	3,86 m
Width:	0,86 m
Hull weight:	32,66 kg
Capacity:	193 kg

• For more information, contact Hobie Cat Southern Africa on 011-792 0414 or visit www.hobie.co.za

FISHING MADE EASY

Put simply, the Mirage Pro Angler is a no-nonsense fishing boat. Its fishing-specific hull form provides great stability, and its deck design is packed with all the essentials – from an easy-to-reach cutting board to a comfortable adjustable seat to space for 13 Plano tackle boxes.

It carries six rods in its horizontal rod stowage area, and its voluminous bow and stern lockers and on-deck storage accommodate an impressive 272 kg payload. In short, it's the perfect boat for all fishing environments, from farm dams to lakes and even the open ocean. A livewell and electric motor are also available as optional extras. Price: R28 000.



SPECIFICATIONS

Hull weight:	39,9 kg
Width:	0,97 m
Length:	4,17 m



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[IN FOCUS]

LANTERN OR HEADLAMP: YOUR CHOICE

Intrepid adventurers on the hunt for a compact, multifaceted light should check out Joby's latest offering, the Gorillatorch Switchback. This combination lantern-headlamp comes with five powerful LEDs, including a 130-lumen spotlight. Featuring six brightness settings and an adjustable dimmer switch, it supplies the right amount of illumination for any outdoors occasion.

As a lantern, it's capable of illuminating an 8-person family tent or small cabin. A flexible stand allows it be hooked inside a tent, placed on a table or attached to a nearby tree branch (it can also be used as a camera tripod).

The Switchback comes with two additional white LEDs for floodlighting and two red LEDs for night vision. Two AA batteries provide up to 72 hours of light. Price: about R600. Available from selected Cape Union Mart stores. Call 0860 034 000 or visit www.capeunionmart.co.za



ARMOURER

When Ryder Washburn graduated from university, he had a decision to make: pursue a career in finance or go into the family business – a company called The Specialists Ltd, which provides weapons for films and television shows. “It turned out that doing armoury work was a lot more fun,” he says.

Washburn started on TV shows such as *Law & Order*; now, 11 years later, the armourer visits sets along the US East Coast, maintaining weapons for *The Bourne Ultimatum*, *Salt* and other movies. The company’s seven armourers work on up to 10 movies and 15 TV series at a time. “If a movie were a Nascar race,” he says, “we’d be the pit crew.” The firm is moving beyond guns: “We started doing fabrication three years ago,” Washburn says. “Making those props – like the catapult for *The Smurfs* – is the most fun.” – Erin McCarthy



Name: RYDER WASHBURN

Age: 33

Location: New York

Years on job: 11

1. AK-47 VARIANT

This firearm is a Chinese version of the world’s most widely manufactured gun: the Avtomat Kalashnikova 47. Movie sets never use real bullets, so, like all the semi-automatic weapons in The Specialists’ arsenal, this AK has been modified to shoot blanks – cartridges that contain gunpowder but no bullet or shot. “Guns are designed to work with real bullets, and blanks don’t have the same operating principles,” Washburn says. “The modifications are different for every gun.”

2. BLOOD KNIFE

For scenes where an actor appears to get cut, productions use blades like this World War I trench knife. “A pipe inside the blade is hooked up to a tube of pressurised blood,” he says. On cue, the knife-wielding actor slashes – and holes in the dull blade funnel fake blood on to the victim, creating the illusion of a gash.

3. NONGUN

One of the most popular “weapons” used in films and television – including *The Sopranos* – is the nongun, which contains a circuit board and electrically fired charges that simulate gunfire. “It looks like a gun,” Washburn says, “but it’s made from scratch, not out of any gun parts.” Nonguns are great for situations so risky – for example, when a character is shot close to the head – that even using blanks is too dangerous.

4. ROCKET LAUNCHER

This genuine AT4 rocket launcher is an anti-tank weapon used by the US military. “They’re considered disposable,” he says, so they modify them for use on sets.

DIY HOME

> BY ROY BERENDSOHN

Q+A

The **FOREST** in the kitchen



Reclaimed timber made attractive shelves in this small kitchen.

Q My wife and I are remodelling our kitchen, and I'm considering using some beautiful reclaimed pine from a local dealer as shelving or trim. Can you give me some tips about working with salvaged wood? My wife is counting on me to do a nice job, and this is my first real woodworking project. Any thoughts on fixing up a kitchen on a tight budget are also welcome.

A Okay, got it. First I'll address working with reclaimed timber; then I'll turn to budget kitchen fix-ups.

Reclaimed timber, especially pine, can be a wonderful material. Barns, boardwalks, houses and warehouses, barracks, factories, bridges, and water tanks and towers are sometimes called the industrial forest. Wood from these structures is extremely high-quality because it comes from beautiful old trees that grew very slowly to a large diameter. The slow growth produces a dense grain pattern because the more slowly a tree grows the narrower its characteristic bands of light- and dark-coloured wood (early and late wood, respectively).

But using reclaimed pine for the purposes you describe can present challenges. It can have small cracks, holes and rust stains left from nails and screws; buried hardware or hardware fragments; insect boreholes; and wear marks from decades of use.

For many, character is part of the charm of reclaimed timber. But if that's not to your taste, you'll have to buy a planer, a table saw and maybe even a jointer and convert the lumber into more uniform, blemish-free stock. Of course, removing these details misses the point and creates a ton of waste.

Regardless of whether you use the timber as you find it or remanufacture it, consider buying a metal detector to find any hardware that may be buried in the wood. But you'll likely miss some metal even after using it – don't be surprised if you end up buying extra blades and bits to replace those damaged by stray hardware.

I hope I don't sound like I'm discouraging you from using reclaimed wood. It just requires a bit more care than new timber. Speaking of which, the less finish you apply, the better. A thin layer of shellac or penetrating oil is all you need to bring out the lovely, dense grain.

Now, on to inexpensive fix-ups. Obviously, you get the most mileage from paint. Other inexpensive touches that can make a dramatic difference are new covers for switches and electrical outlets, and cabinet knobs or pulls. And even though you can't

see it, a trash-can slide is always worth adding. New blinds go a long way toward improving a kitchen's appearance. In fact, I'd consider making a window valance from some of the reclaimed wood. It could be the crowning touch.

After all the painting is done and the hardware replaced, I think your wife will be pleased – and so will you.

FLIPPING THE LID

Q It's high time we had our septic tank pumped. The problem is that the company that does the work says we could save a considerable amount of money if we locate the lid rather than hire them to do it. What's the quickest way to find the lid?

A Unfortunately, there's no foolproof answer here. Typically, you begin the search inside the house, not outside. Look for the point where the building's main drain exits the foundation. In most cases, the drain runs perpendicular to the foundation for about 3 metres and meets up with the septic tank. However, that distance can be as little as 2 metres.


You can also check with the municipality, which may require that the position of the tank and the rest of the house's waste system be indicated on a plot plan or a similar document.

If you have the plans, use a tape measure to locate where the tank is. Probe with a shovel or use a digging bar with a sharp tip. The top of the septic tank will be anywhere from 10 cm to 30 cm below ground. When digging a test hole, remember to remove a square patch of sod so that it can be easily put back into place after the tank is pumped or when you go to make another test hole.

Sometimes a tank lid is easy to find and requires no more than half an hour to an hour of careful probing and digging; other times it can take a couple of hours. It makes you appreciate why some pumping companies now use flushable transmitters. The pumping contractor flushes a transmitter down a toilet and then finds it by sweeping over the ground with a locator. Other companies use a metal detector to seek out the piece of bent rebar that is sometimes cast into a tank's concrete lid. In any case, you're making a smart move by locating the tank yourself.

THE SEAL DEAL

Q I'm going to seal my asphalt driveway. I've never done this before, and I don't want to make a mess out of it. I



DON'T THROW IT OUT

THE FIX FOR STRIPPED HOLES

WHAT TO KEEP
→


Braided copper earth wire clipped from old light fixtures; electrical screws of various sizes.

WHY YOU KEEP 'EM
→

It's not unusual when you change a light fixture mounted to a plastic box that the holes for the mounting screws strip out.

HOW TO USE 'EM
→

Slip a piece of the braided copper earth wire into the stripped hole and clip off excess wire so that none protrudes. Drive the mounting screw as you normally would. You can also use an electrical screw that's one size larger. Carefully drill out the stripped hole and drive the bigger screw. In some cases, you can skip the drilling and just drive the screw.



would appreciate any advice you can give me about what kind of sealer to use and the best way to do this work.

A Sealing a driveway is about as simple as DIY projects go, and freshly sealed asphalt can make a world of difference to a home's attractiveness, not to mention greatly increase the pavement's durability.

Begin by cleaning the driveway with a stiff-bristle broom or a leaf blower. Scrape clean any cracks that are filled with weeds (use an old reciprocating-saw blade for this). Patch and firmly compact potholes with cold-patch asphalt, and seal cracks with crack filler. To repair large cracks, either pack the bottom with sand or lay in a length of foam backer rod before applying crack sealer. Next, apply oil-spot primer to greasy spots with an old paintbrush. This prevents the spot from bleeding through the seal coat.

Finally, use masking tape, paper and sheet plastic to protect adjoining surfaces, such as sidewalks, foundation walls, garage doors or floors, or retaining walls. Sealer that gets splashed accidentally on these surfaces is nearly impossible to remove.

You've got several choices of driveway sealer. Coal-tar sealant is the traditional product; its primary component is the refined tar formed when bituminous coal is converted to coke, a steel-making fuel.

Coal-tar sealer is still the go-to material of the road-sealant industry; it's favoured because it resists degradation from the Sun's UV rays and doesn't dissolve easily when blemished by motor oil and automotive chemicals.

Coal tar, however, is at the centre of an ongoing controversy. In 2006, Austin, Texas, banned asphalt sealers that contain the material, citing a study that found polycyclic aromatic hydrocarbons (PAHs) had accumulated in waterways. An industry trade group, the Pavement Coatings Technology Council, fired back with counterstudies that took that research to task for flawed methodology, and noted that PAHs are also found in automotive exhaust and the residue from burning wood and charcoal, among other sources.

Where does that leave you? Coal-tar sealants are still readily available, but if the possible environmental risk concerns you, then your best choice is to use a sealer formulated from asphalt emulsions (which contain a tiny fraction of the PAHs found in coal-tar formulations). There are also sealers made from acrylic emulsions. Although I haven't seen data on PAHs in acrylics, I would estimate that their level is at least as low as in asphalt emulsions and probably lower. Expect to pay three to four times the price of asphalt-emulsion blends if you go the acrylic sealer route.

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Chuck Capacity	1.5 - 13mm
Power Output	350 Watts
No Load Speed	0-600/2000rpm
Max. Torque	35Nm
Max. Drilling Capacity	Wood 38mm Metal 13mm
Weight	1.84kg
Length/Height	190 x 236mm

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LITHIUM ION**SPECIFICATIONS**

Battery Capacity	1.3 Ah
Chuck Capacity	1.5 - 10 mm
Power Output	180 (MWO) Watts
No Load Speed	0-400/0-1500 rpm
Max Torque	25 Nm
Max. Drilling Capacity [Wood]	19 mm
Max. Drilling Capacity [Metal]	10 mm
Weight	1.1 kg
Length x Height	85 x 195 mm

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Regardless of the sealer you use, reduce chemical-containing run-off from the driveway by applying the sealer when the forecast is for dry weather. The longer the post-application stretch of dry weather, the better. The sealer should have a chance to cure before it rains.

TEST PILOT

Q My detached garage has a "granny flat" whose water is heated with a ceiling-hung gas unit, and the pilot flame often blows out when I open the garage door. Obviously, this is a nuisance. What's the solution? I can't always bring in tools, equipment and materials through the side door.

A First, have a heating contractor inspect the furnace. Yes, a pilot flame can easily be blown out by high wind, but it's also possible that the pilot flame is weak or that the furnace needs a tune-up. A weak pilot flame can be caused by gas pressure that's too high or too low, a dirty pilot-light orifice or just ordinary wear and tear – to name a few of the many causes. A quick visual check can confirm whether the flame has a light blue colour and a correct shape, which can range from that of a bullet to the form of a butterfly wing seen from above.

Ruling out a weak pilot, you might ask your heating and cooling contractor to install an aftermarket automatic relighter. This device produces a stream of ignition sparks until the pilot relights itself or the thermocouple cools to the point that the gas-control valve closes, shutting off gas flow to the appliance.

TOOL LURKER

Q I'm a longtime reader and online lurker of all things PM. I'm beginning to take on new home projects, so I'm requesting more tools for special occasions like my birthday. I point family members to your Web site and ask for the tools that you recommend. But that means I've got many different brands of power tools. Is there one brand that ranks best overall? This would be particularly helpful to know concerning cordless power tools, so that I can swap batteries as much as possible.

A We get asked this question a lot. The simple answer is no. Over the past 20 or so years, we've found that each manufacturer has at least one strong suit. For example, we haven't seen a reciprocating saw yet that can outcut the iconic Milwaukee Super Sawzall, and Bosch's jigsaw handily beat all comers in a recent test. Among cordless tools, we've had consistently high results from Bosch, Makita and Milwaukee, to name three professional brands. DeWalt, Ridgid and other well-known names in the industry also perform very well in our tests, and some less expensive brands such as Hitachi and Ryobi provide more than enough performance for homeowner needs.

Even within brands, you might be attracted to smaller, low-voltage tools that take a stick-type battery that fits in the handle, while larger tools of the same marque use a larger, slide-on type of battery. If you find yourself needing to swap batteries among various tools, buy a combo kit, such as one that contains a drill, a circular saw and a reciprocating saw.

I suppose I'm just stating the obvious, but sooner or later manufacturers should settle on a standard battery configuration. Yes, we've heard a lot of reasons from manufacturers over the years about why this isn't possible. But then again, other industries have put this kind of squabbling behind them and moved on to successful standardisation. It's time for the power tool industry to do this, too.

PM

COOL STUFF

2011

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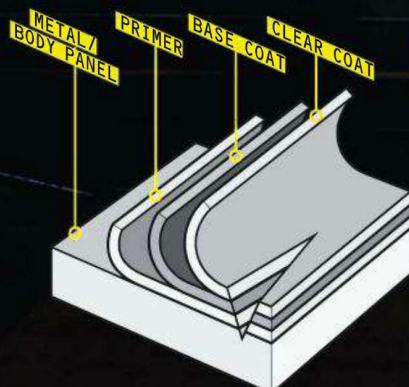


This is a classic example of a repair gone bad. The previous owner of this door tried to sand out a scratch that went into the primer. That darker paint is the colour under the clear coat.

FIXING paint scratches

A few minutes' worth of careful filling and polishing can make most paint scratches nearly disappear.

> BY MIKE ALLEN



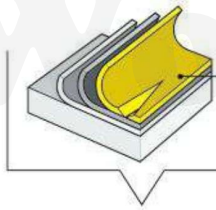
**ANATOMY
OF A SCRATCH**

➔ New car + parking lot = scratches and chips. It's a fact of life. Other people often don't treat your car's paint with much consideration. Ditto for kids and pets, not to mention the odd troll with an attitude and a set of car keys. Respraying a car can cost thousands of

rand; respraying a single panel may leave you with a clown car that doesn't match colour left to right.

Fortunately, many small nicks, scratches and imperfections can be easily retouched. A careful job is unobtrusive and may well be almost totally invisible.

Clear-coat scratch



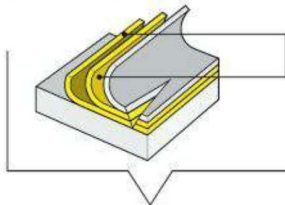
Minor scratches, ones that don't go through the clear coat into the colour, or areas of low gloss or orange-peel texture can often simply be polished out with compound. Yes, this removes some

of the clear coat, so polish the minimum area necessary or you'll have to respray some of that protective top layer. Thoroughly clean the panel after you're done to remove the abrasive compound.



(1) Clean the surface first to remove surface dirt. Masking nearby trim with tape might be wise, especially if it's chromed plastic. Apply a small amount of polishing compound to the pad that comes with it, or even to a terry cloth or microfibre cloth.

(2) Polish a small area. After a couple of dozen strokes, use a clean cloth to buff the area dry. Check your progress, and repeat if necessary. Go slowly to avoid sanding through the clear coat, and check often to see if the scratch is still visible.



Base-coat/primer scratch

You'll need to get some matching paint. This same procedure can be used to repair primer-coat scratches by brushing in a layer of primer first, then sanding the overrun until it covers only the bottom of the scratch. **Don't skip that step:** you'll have poor adhesion and/or rust.

(1) Clean the panel with solvent to remove any oils or wax. Carefully apply primer or colour to the scratch. Yes, you'll have paint overlapping the damaged area; it's okay, but work carefully and minimise any lap. **(2)** Let the paint cure at least overnight. With a sponge or rubber block as a backing, wet-sand with 600- or 1000-grit wet-or-dry sandpaper until any paint standing proud of the surface is gone. Work slowly, stopping often to clean the area and check your progress. **(3)** Use compound to chase the gloss back into the damaged area. This will keep the sanded area more closely contained. **(4)** You will probably have low spots. Apply more paint, and repeat until the scratch is filled and level. A final compounding should restore the finish's shiny factory gloss. Don't wax for 30 days to allow solvents to escape.



PROPER CONDITIONS: BE COMFORTABLE

Before you break out your touch-up tools, figure out what you're dealing with. If the scratch appears thin and white, it probably hasn't penetrated through the clear coat. If it is body-coloured or shows metal, you've got a deeper problem. Regardless, never try to touch up paint unless the temperature in your work area is shirt-sleeve-comfortable for you. The paint won't adhere, dry properly or gloss up.

The ideal temperature would be in the 20s, but 15 to 30 is acceptable. You'll need to be out of the wind and sun. Indoors is best, but a shady carport should do. The relative humidity should be less than 60 per cent or so: the evaporating solvent will cool off the panel as it dries, potentially lowering the metal's temperature below the dew point and letting moisture condense on the surface. This is not conducive to good surface finish.

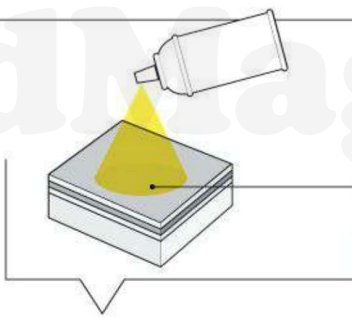
PATIENCE

Unless the car you're repairing is over 20 years old or was custom-painted, the paint is almost certainly a clear-coated catalysed enamel. Artificially hardened by toxic chemicals, it's stable within hours of factory application.

On the other hand, the paint you're applying, whether it's primer, colour or clear, is a lacquer. Lacquers dry because the solvent evaporates, leaving the solids behind. Although they may feel hard and be sandable within a few minutes, they will continue to shrink for a while. Allow lacquers to dry at least overnight so they can shrink before you add another coat. If you need multiple coats to build up the paint film to full thickness for a repair, one coat a day is best. Of course, be safe. The amounts of solvents used are small, but work in a well-ventilated area. Make sure to degrease the area with solvent before starting.

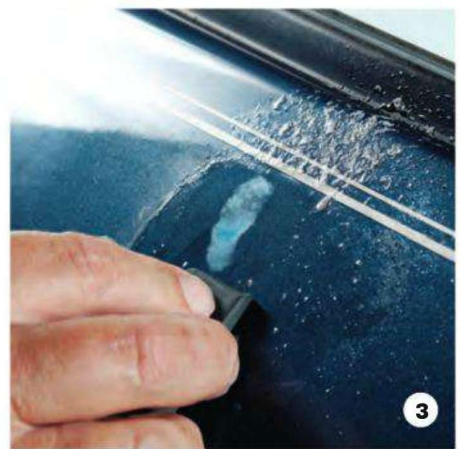
CRACKING THE CODE

Somewhere on your car should be the factory-paint code, probably on a sticker or metal plaque under the hood or in the door-sill. This will help a great deal in finding the correct touch-up. It's amazing how many similar colours there are in any car manufacturer's palette in a single model year. If you can't match the colour in the display of touch-up paints at the automotive paint or spare parts store, your next, albeit expensive, step is the parts counter at the car dealer, at least if you have a car that's less than 10 to 15 years old. If you're really stumped, an automotive paint dealer can custom-mix you a small amount; take in a sample, like the fuel filler cap or a mirror. **PM**



Spraying clear coat

Oops – if you've sanded through the clear coat or have repaired a deep scratch, you'll need to apply clear coat. Buy a rattle can of automotive clear coat. Ordinary clear enamel won't work – it has to be automotive paint intended for spot repairs. Rust-Oleum is one example of an appropriate product in aerosol cans. Here's how to keep the repaired area small and unobtrusive.



(1) Clean the surface with solvent to remove oils and wax. Cut a coin-sized hole in a piece of paper for smaller blemishes to avoid overspraying – you could also mask the area. **(2)** Hold the paper a few centimetres from the panel and spray a light, dry coat through the hole. If it sags, you've sprayed too much. If it's shiny, you've sprayed too much. Let this dry. **(3)** Using 600- or 1000-grit wet-or-dry

sandpaper on a sponge or rubber block, sand off any excess. This step is necessary to level the clear coat in the blemish, and also to keep the affected area from getting increasingly large as you add subsequent coats. As in a brush touch-up, compound the affected area to remove sanding scratches. Repeat this process with at least two coats, allowing 24 hours between coats.

PRODUCTS:

Walk into any car parts environment and you'll see a variety of kits and products. I've always had polishing compound and fine sandpaper around the workshop. That's really all you need, but it's handy to have everything in one box. Some kits have the primer and clear already on board – all you really need in addition is the proper colour paint and a place to work.

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Q When I think I'm going to be stopped in my car for 20 seconds or more, like at a drive-through window, I shut off the engine. My son argues that it is going to take more fuel to restart the engine than I will save by shutting it off. Is there some rule of thumb on the break-even point for shutting off versus letting the engine run?

A Engines consume petrol while idling – 8 to 20 litres per hour. They consume no petrol when shut down. It takes essentially zero fuel to restart a warm engine. Do the math. That's why hybrids and some new cars shut down the engine at traffic lights – to conserve fuel – restarting automatically when your foot comes off the brake so the car is ready to go by the time you get to the accelerator. I don't know where this misconception came from, but it constantly comes up in my mail.

Actually, I think I may know where it came from. In days of old, when cars had carburettors and chokes, a cold start involved closing the choke to make the mixture richer, sweetened by a few pumps of the accelerator, which pumped a half-spoonful or so of raw fuel into the intake at every stroke. The extremely rich mixture ensured that enough petrol was in its vapour (not liquid) phase when the spark plugs fired; otherwise, the wet petrol drops wouldn't ignite.

Once the engine caught, the choke had to stay on for several minutes, or the cold valves and piston would keep the petrol liquid. It would take several minutes of fast idling or choke-on driving to bring the engine up to normal operating temperature. That, of course, consumed fuel more rapidly until the engine warmed up. An inappropriate generalisation from that phenomenon may have led to the misconception that engines (modern, fuel-injected engines that are already warmed up) need substantial amounts of fuel to restart when shut off briefly.

One downside: you may need to replace your starter motor prematurely. Vehicles with idle shut-off use either an uprated starter or combine the starter function with a hybrid traction-assist motor.

Let me in!

Q The wireless key fobs (both of them) work to lock the doors and open the boot of my car, but not to unlock the doors. Any way to fix this?

A Okay, the transmitters in the fobs are working, as is the receiver in the car, or you'd get no response at all from the remote. I'm going to assume that you can unlock the doors with the central locking system from inside the car without the key fob, or you would have mentioned otherwise. That leaves only one variable: the unlock button on the key fob itself. Times two, of course.

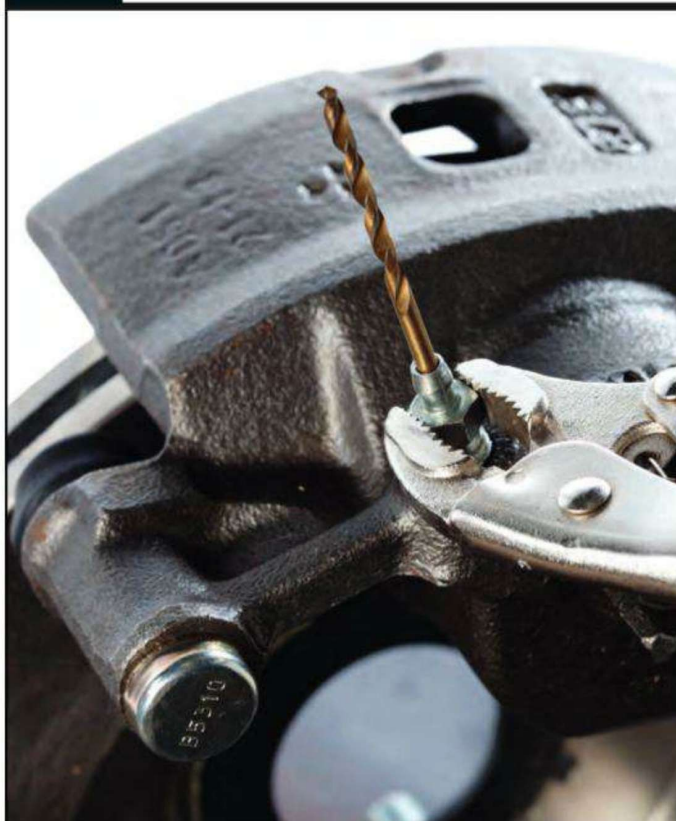
Normally, when I have a bad key fob, I pick up a generic remote at the spare parts store and use the remaining working remote to program it. (No surprise, these units are far cheaper than the dealer-sourced ones.) Follow the directions on the replacement fob, since they're too complicated to list here.

Unfortunately, in your case, both remotes aren't working properly, which makes reprogramming a new one tough. I



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I hate brake work – well, at least when someone brings me some neglected vehicle that hasn't had any scheduled maintenance in ages. Any kind of brake work – whether it's something episodic like replacing a failed brake pipe, or periodic maintenance – means bleeding the brakes.

Hah. You try turning those minuscule, 7-mm hex-head bleeder bolts after they've marinated in road muck for a generation. They're made of fairly soft steel (probably so the tapered valve seat at their inside end has a chance of sealing properly against the hard, cast-iron seat inside the calliper), and that means they round off easily.

First rule: Use a ring spanner

or six-point socket to break them loose.

When they do round off, the first thing most people try is to grip them with vice-grips. Nope, see above for discussion of soft steel. If you reef down enough on the vice-grips to get a good purchase, the soft steel (ditto) bolt, which is hollow, will collapse and break off clean at the surface of the calliper.

To avoid the collapse, I fill the hole in the centre of the bolt with the shank end of a twist drill, choosing one from the drill stand that just barely fills the hole. It keeps the bleeder bolt from squashing flat, and because it's smooth, it's easy to extricate later.

predict the issue is bad electrical contacts inside the fob. Pry or unscrew it open. Find the small microswitches soldered to the printed circuit board and hose them down with contact cleaner. Try the lock button again. If that works, immediately acquire a generic fob and use the now-functioning OEM fob to program it, because odds are it will fail again sooner or later.

Braking bad

Q Back when I learned to drive, my dad taught me to always apply the parking brake before shifting the transmission to Park on an automatic. He told me that this served two purposes. First, applying the parking brake before shifting the transmission into Park took the pressure off the transmission, thereby preventing the failure of the pin that drops into the transmission when shifting into Park. Second, applying the parking brake recalibrated or reset the brake cable, thereby keeping the rear-drum brakes in optimum operating condition.

Recently, I took my 2000-model vehicle with automatic transmission for scheduled maintenance. The technician recommended a brake job, which seemed reasonable given the number of years since the last brake job. Somewhere in our conversation I mentioned that I always use the parking brake, and the technician gave me the business about my excessive use of it. This leads me to two questions for you. First, was my father correct in what he taught me 30 years ago? Second, do those same lessons hold true today on these new-fangled cars with their fancy disc brakes and such?

A Your father was right on the money. Still is. Regular use of the parking brake – often erroneously referred to as an emergency brake – is a good practice. I do think the advice

about taking the pressure off the parking pawl is probably overcautious, unless you live on a steep hill or someplace where your parked car is likely to be creamed by passing traffic. Keeping the parking-brake cable from freezing up from disuse, however, is good advice, even today with four-wheel disc brakes being commonplace. If the cable doesn't get regular exercise, it'll freeze, especially the part of it that's hanging below the chassis and is constantly bathed in muck. Ditto for the self-adjusting system built into the rear backing plate or rear calliper.

Out of control

Q Is anyone coming up with a decent cruise control? Engine sizes are coming down and efficiencies are going up, but the power-to-weight ratios cause the engines to redline in hilly country when the cruise pushes the pedal to the floor. What is needed here is an engine-throttle limiter that would work up to the requested top speed more slowly. In my four-cylinder, I would be much happier with the speed selection being more of a suggested upper limit than a demand.

A The problem isn't in the cruise control. As you suggest, the power-to-weight ratio is lower on many small vehicles. This necessitates more throttle to negotiate hills, which in turn eventually makes the transmission downshift with a bang to try to maintain speed. Some manufacturers, specifically ones with a more expensive product than your vehicle, have engine controls with more intelligence: they are less prone to downshifting when in cruise-control mode than not, specifically to avoid this issue, which is referred to as hunting. On longer hills, the vehicle will go back and forth repeatedly between two gears as the transmission searches for the sweet spot.

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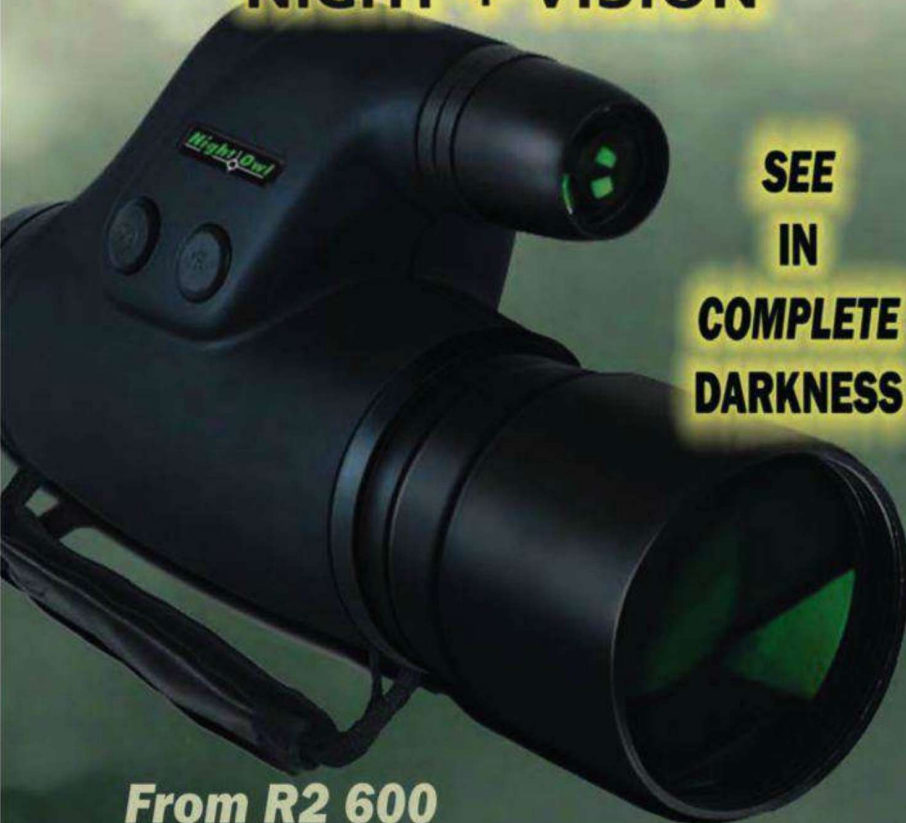
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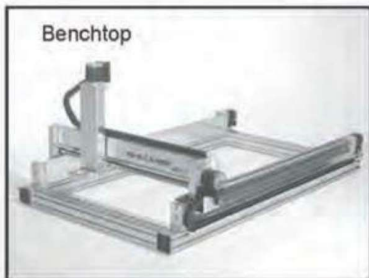
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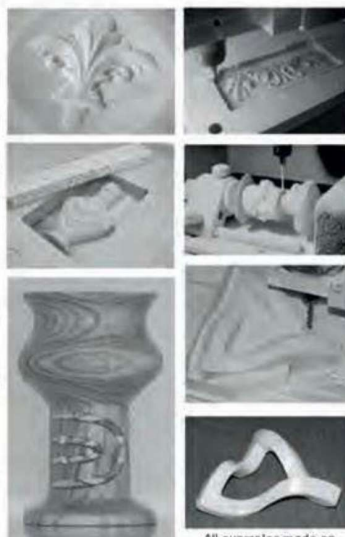
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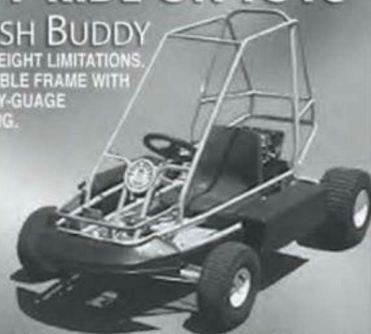
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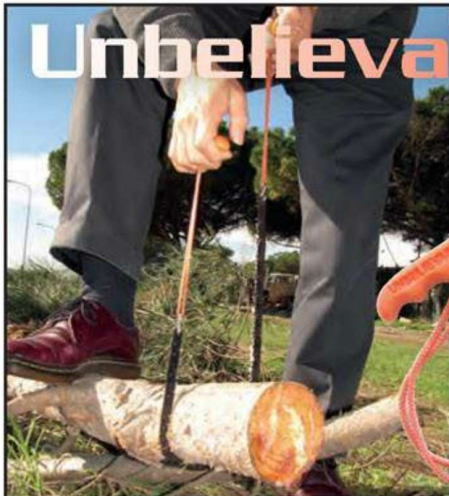
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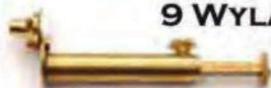
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WINNING TIP

Beef up your toolbox

I recently bought a quality tool set packed into a cantilever box, but found that the pre-formed plastic that held the sockets and ring spanners was very flimsy, and tended to split or break. My solution: buy a can of expanding foam, take out the tools, turn the plastic holders upside down and fill the cavity with the foam. Once it has dried, you can cut off any excess with a hacksaw blade, leaving you with a rigid and more durable tool tray.

KEITH GALES
HONEYDEW



New angle on art

Artists' equipment is expensive, and this also applies to framing equipment. Here's a cheap way to tighten frames that you've made yourself. The commercial tools cost in excess of R300; this method will set you back less than R50. Take a luggage strap of the type used for securing luggage to your bakkie and connect the two ends to form a loop, which you then place around your frame to tighten it (see photo).

Place four metal plates, each bent into a 90-degree L shape, between the wood and the strap to eliminate the risk of seeping glue becoming attached to the strap. To ensure that the corners are at a true 90-degree angle, measure across the opposite corners: the distance should be exactly the same.

CLARK BOTHA
ROODEPOORT NORTH

Sucking up

Nowadays, many people have GPS units mounted in their vehicles. The most common mount employs a suction cup for attaching the device to the inside of the windscreen, and one usually wets (or licks) the inside of the suction cup to create a good seal. Unfortunately, this "sealing liquid" tends to evaporate fairly quickly, so the vacuum in the suction cup doesn't last forever, with the result that the GPS



New broom paints clean

It may be difficult, and occasionally painful, to repaint your roof while perched on your hands and knees and using a roller. We found it much easier to tackle the job using an ordinary broom of the sort you can buy from any department store for R30; the broom makes longer and more even sweeps. That accomplished, all you need do is use a broad paintbrush to touch up the edges where the broom can't reach.

WILLIAM ELLERBECK
PRETORIA

is liable to fall off at any time. I have found a way to extend its stay – in my case, from two weeks to about two months (and counting). Before pressing the suction cup against the windscreen, spray the inside with a light oil, preferably silicone (I used Spanjaard Silicone Spray). Next, position the cup at the desired spot; this is easy because the oil enables you to slide it to exactly where you want it.

Finally, flip the lever on the mounting, and there you are. Since the oil evaporates only slowly (if at all), the GPS will stay in place far longer, even in the hot sun. All that remains to do is clean off any oil smears on the windscreen with a paper

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towel. One last thing: the GPS should ideally be mounted as close as possible to the bottom-right corner of the windscreen. This ensures that it is easily viewed without interfering with the driver's line of sight.

CHRIS GRAHAM
RANDBURG

DIY funnel

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LOUIS MULDER
VIA E-MAIL PM

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